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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 :		(11) International Publication Number:
A61F 13/15	A1	WO 92/22274
		(43) International Publication Date: 23 December 1992 (23.12.92)

(21) International Application Number: PCT/US92/04775

(22) International Filing Date: 8 June 1992 (08.06.92)

(30) Priority data:
714,476 13 June 1991 (13.06.91) US

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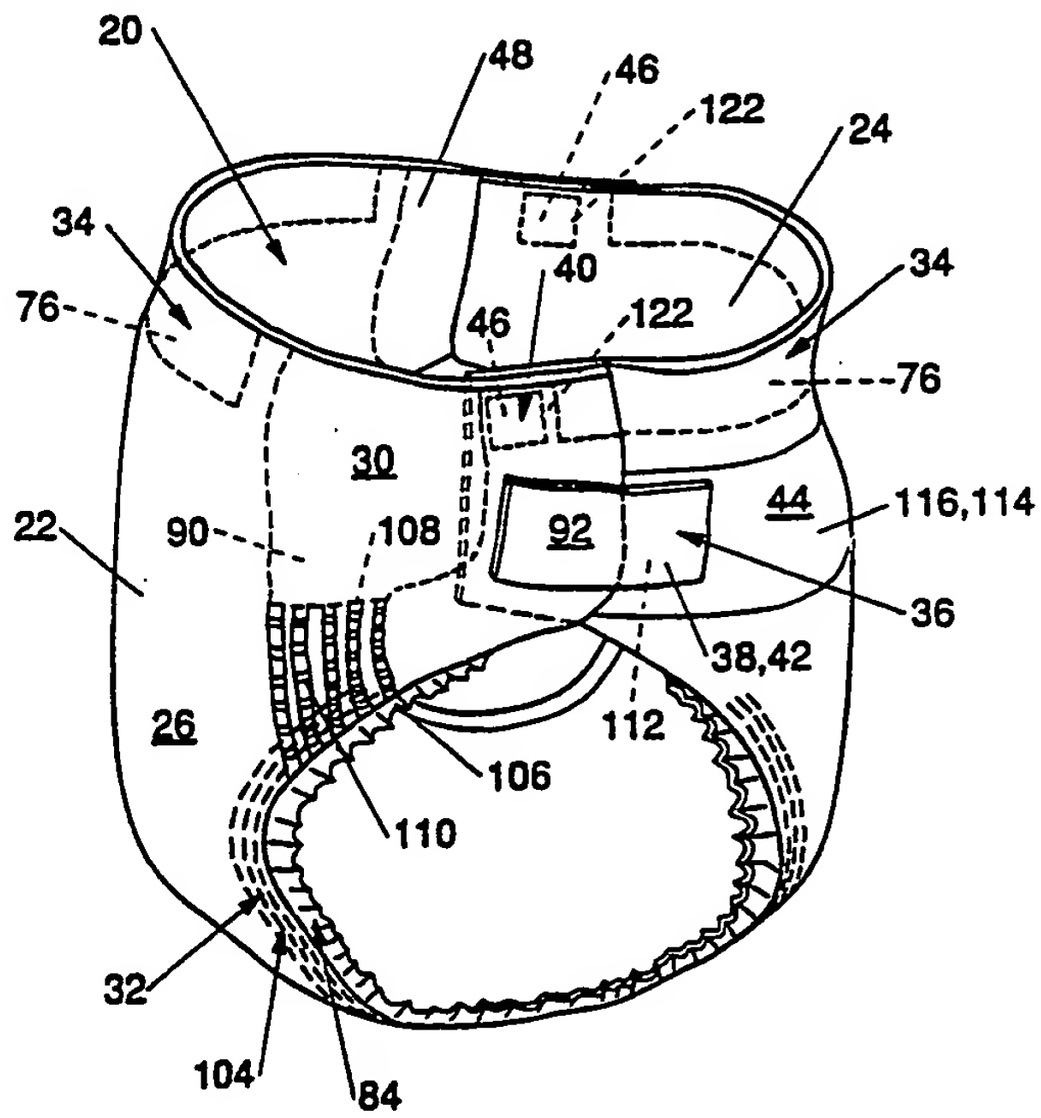
(81) Designated States: AT (European patent), AU, BB, BE (European patent), BF (OAPI patent), BG, BJ (OAPI patent), BR, CA, CF (OAPI patent), CG (OAPI patent), CH (European patent), CI (OAPI patent), CM (OAPI patent), CS, DE (European patent), DK (European patent), ES (European patent), FI, FR (European patent), GA (OAPI patent), GB (European patent), GN (OAPI patent), GR (European patent), HU, IT (European patent), JP, KP, KR, LK, LU (European patent), MC (European patent), MG, ML (OAPI patent), MN, MR (OAPI patent), MW, NL (European patent), NO, PL, RO, RU, SD, SE (European patent), SN (OAPI patent), TD (OAPI patent), TG (OAPI patent).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: ABSORBENT ARTICLE WITH FASTENING SYSTEM PROVIDING DYNAMIC ELASTICIZED WAISTBAND FIT

(57) Abstract

Absorbent article such as disposable diapers, incontinent briefs, diaper holders, and the like, that have elasticized waistbands (34) with a dual tensioning fastening system that improves the dynamic fit of the elasticized waistband as well as the containment characteristics of the absorbent article. The dual tension fastening system comprises a primary fastening system (38) and a waist closure system (40). The waist closure system (40) forms a waist closure that anchors a portion of the end edge of the absorbent article and that dynamically maintains/creates lateral tensions through the elasticized waistband so as to improve the fit and containment characteristics of the diaper by reducing gapping, sagging, and roll-over of the elasticized waistband. The absorbent article additionally preferably comprises a pair of elasticized side panels (30) disposed in the second waist region. The elasticized side panels preferably comprise a "zero strain" stretch laminate and also preferably having an extension panel (110) adjacent the leg of the wearer.



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ABSORBENT ARTICLE WITH FASTENING SYSTEM PROVIDING DYNAMIC ELASTICIZED WAISTBAND FIT

FIELD OF THE INVENTION

The present invention relates to absorbent articles such as diapers, incontinent briefs, diaper holders, and the like, and more particularly, to absorbent articles having elasticized waistbands wherein the fastening system of the absorbent article improves the dynamic fit of the elasticized waistband about the wearer as well as the containment characteristics of the absorbent article.

BACKGROUND OF THE INVENTION

Infants and other incontinent individuals wear absorbent articles such as diapers to receive and contain urine and other body exudates. Absorbent articles function both to contain the discharged materials and to isolate these materials from the body of the wearer and from the wearer's garments and bed clothing. Disposable absorbent articles having many different basic designs are known to the art. For example, U.S. Patent Re. 26,152, entitled "Disposable Diaper" issued to Duncan and Baker on January 31, 1967, describes a disposable diaper which has achieved wide acceptance and commercial success. U.S. Patent 3,860,003, entitled "Contractable Side Portions For Disposable Diaper", issued to Buell on January 14, 1975, describes an elasticized leg

cuff disposable diaper which has achieved wide acceptance and commercial success.

However, absorbent articles have a tendency to sag or gap away from and to slide/slip down on the body of the wearer during wear. This sagging/gapping and sliding/slipping is caused by the relative motions of the wearer as the wearer breathes, moves and changes positions, by the downward forces generated when the absorbent article is loaded with body exudates, and by the deformation of the materials of the absorbent article itself when subjected to such wearer's motions. This sagging/gapping and sliding/slipping of the absorbent article can lead to premature leakage and poor fit of the absorbent article about the wearer in the waist regions and the leg regions of the absorbent article.

In order to more snugly fit absorbent articles about the waist of the wearer, certain commercially available absorbent articles have been provided with elasticized waistbands. An example of a disposable diaper with an elasticized waistband which has achieved wide acceptance and commercial success is disclosed in U.S. Patent 4,515,595 issued to Kievit and Osterhage on May 7, 1985. Elasticized waistbands will typically comprise an elastic member contractibly affixed between the topsheet and the backsheet. The elasticized waistband is, thus, designed to expand and contract with the wearer's motions and to maintain the fit of the absorbent article about the waist of the wearer during use (i.e., provide sustained dynamic fit).

However, it has been found that absorbent articles having elasticized waistbands also have a tendency to sag/gap and slide/slip during use. Further, the elasticized waistband feature has a tendency to rollover or roll-in at the front of the diaper resulting in a lack of fit about the waist of the wearer.

Thus, it would be advantageous to provide an absorbent article having an elasticized waistband that provides better fit, reduced leakage, and wearer comfort. It would further be advantageous to provide an absorbent article which has reduced sagging, gapping, rollover, or roll-in at the waist of the diaper as well as reduced overall sliding/slipping of the absorbent article or the absorbent core on the wearer during use.

Therefore, it is an object of the present invention to provide an absorbent article having sustained dynamic fit of the absorbent article on the wearer during use.

It is a further object of the present invention to provide an absorbent article having an elasticized waistband having sustained dynamic fit that provides improved resistance to leakage during use.

It is a still further object of the present invention to provide an absorbent article providing sustained dynamic fit of the elasticized waistband by reducing sagging, gapping, rollover or roll-in of the elasticized waistband as well as overall sliding/slipping of the absorbent article or the absorbent core during use.

It is another object of the present invention to provide a fastening system that provides such sustained dynamic fit for the elasticized waistband.

It is a further object of the present invention to provide a waist closure system that maintains/creates lateral tension through at least a portion of the elasticized waistband to provide sustained dynamic fit.

These and other objects of the present invention will be more readily apparent when considered in reference to the following description and when taken in conjunction with the accompanying drawings.

SUMMARY OF THE INVENTION

The present invention provides absorbent articles such as disposable diapers, incontinent briefs, diaper holders, and the like, that have elasticized waistbands with a dual tension fastening system that improves the dynamic fit of the elasticized waistband as well as the containment characteristics of the absorbent article. Such absorbent articles comprise a containment assembly preferably comprising a liquid pervious topsheet, a liquid impervious backsheet, and an absorbent core positioned between the topsheet and the backsheet; an elasticized waistband; and a dual tensioning fastening system.

The dual tension fastening system comprises a primary fastening system for forming a side closure and a waist closure system for forming a waist closure. The primary fastening system maintains the first waist region and the second waist region in an overlapping configuration such that lateral tensions are maintained around the circumference of the diaper to maintain the diaper on the wearer. The primary fastening system comprises a securement member, preferably a tape tab and a first fastening component, and a landing member preferably comprising a second fastening component to provide a variable positioning side closure. The waist closure system forms a waist closure that anchors a portion of the end edge of the absorbent article and that dynamically maintains/creates lateral tensions through the elasticized waistband so as to improve the fit and containment characteristics of the diaper by reducing gapping, sagging, and rollover of the elasticized waistband. The waist closure system comprises at least one, preferably a pair of, first attachment component(s) longitudinally aligned with the elasticized waistband and at least one second attachment component. Each attachment component comprises a fastening means that engages a complementary fastening means for providing a variable positioning, passively activated, waist closure. The first attachment component(s) preferably comprise a hook fastening material while the second attachment component preferably comprises a loop fastening material.

In an especially preferred embodiment of the present invention, the absorbent article additionally comprises a pair of elasticized side panels disposed in the second waist region. The elasticized side panels provide an elastically extensible feature that provides a more comfortable and contouring fit by initially conformably fitting the diaper to the wearer and by sustaining this fit. The elasticized side panels further develop and maintain wearing forces (tensions) that enhance the tensions developed and maintained by both the primary fastening system and the waist closure system. The elasticized side panels especially assist in pre-tensioning the elasticized waistband and further provide more effective application of the diaper. While each

elasticized side panel may be constructed in a number of configurations, the elasticized side panel preferably comprises a "zero strain" stretch laminate. The elasticized side panel also preferably has an extension panel adjacent the leg of the wearer so that tensional forces through the side panel are not concentrated so as to prevent the indentation, rubbing, or chafing of the wearer's skin during use.

The present invention also relates to an alternative elastic waist feature comprising an "expansive tummy panel" elasticized waistband. In this alternative embodiment, the elasticized waistband is capable of expanding well beyond the dimensions of the absorbent article set by the primary fastening system (beyond the planar state of the diaper itself) so as to accomodate wearers, especially large infants, with large expansile waists so as to reduce the sagging/slipping of the absorbent article. The extension forces of the elasticized waistband are lower than the extension forces of the elasticized side panels so as to accomodate such expansion. In a preferred embodiment of this elastic waist feature, the elasticized waistband is formed from a stretch laminate. The stretch laminate is comprised of an elastic waistband member and a portion of the topsheet and the backsheet which all have been mechanically stretched. In a preferred embodiment, this elastic waist feature is formed by removing a portion of the backsheet (windowing). The shape of the elasticized waistband also provides differential extensibliity in the lateral direction.

BRIEF DESCRIPTION OF THE DRAWINGS

While the specification concludes with claims particularly pointing out and distinctly claiming the subject matter which is regarded as forming the present invention, it is believed that the invention will be better understood from the following description which is taken in conjunction with the accompanying drawings in which like designations are used to designate substantially identical elements, and in which:

Figure 1 is a plan view of a disposable diaper embodiment of the present invention having portions cut-away to reveal

underlying structure, the outer surface of the diaper facing the viewer;

Figure 2 is a fragmentary sectional view of the disposable diaper shown in Figure 1 taken along section line 2-2 of Figure 1;

Figure 3 is an inverted fragmentary sectional view of the disposable diaper shown in Figure 1 taken along section line 3-3 of Figure 1;

Figure 4 is a perspective view of the disposable diaper embodiment of Figure 1 in a typical in-use configuration as applied to a wearer;

Figure 5 is a fragmentary plan view of an alternative diaper embodiment of the present invention showing an elasticized waistband of an "expansive tummy panel" having differential extensibility in the lateral direction and a "windowed" elasticized waistband;

Figure 6 is a fragmentary plan view of an alternative embodiment of the elasticized waistband shown in Figure 5;

Figure 7 is a plan view of a further alternative disposable diaper embodiment of the present invention showing an alternative configuration for the waist closure system;

Figure 8 is a simplified perspective view of an apparatus that employs a vacuum web restraint system for mechanically stretching a portion of a diaper web using meshing corrugated rolls;

Figure 8A is a simplified view taken along line 8A-8A in Figure 8 showing the manner in which idler rolls are used to cause the diaper web to wrap the lowermost corrugated rolls;

Figure 8B is a highly enlarged view taken at the inset 8B shown in Figure 8, showing the degree of meshing of the corrugated rolls with one another as the "zero strain" stretch laminate portion of the diaper web passes therebetween;

Figure 9 is a simplified perspective view showing an alternative web restraint system of the present invention which may be used during the incremental stretching process disclosed herein; and

Figure 9A is a highly enlarged simplified cross-sectional view taken at inset 9A shown in Figure 9 along a centerline

connecting the uppermost corrugated rolls and the lowermost corrugated rolls.

DETAILED DESCRIPTION OF THE INVENTION

As used herein, the term "absorbent article" refers to devices which absorb and contain body exudates, and, more specifically, refers to devices which are placed against or in proximity to the body of the wearer to absorb and contain the various exudates discharged from the body. The term "disposable" is used herein to describe absorbent articles which are not intended to be laundered or otherwise restored or reused as an absorbent article (i.e., they are intended to be discarded after a single use and, preferably, to be recycled, composted or otherwise disposed of in an environmentally compatible manner). A "unitary" absorbent article refers to absorbent articles which are formed of separate parts united together to form a coordinated entity so that they do not require separate manipulative parts like a separate holder and liner. A preferred embodiment of an absorbent article of the present invention is the unitary disposable absorbent article, diaper 20, shown in Figure 1. As used herein, the term "diaper" refers to an absorbent article generally worn by infants and incontinent persons that is worn about the lower torso of the wearer. It should be understood, however, that the present invention is also applicable to other absorbent articles such as incontinent briefs, incontinent undergarments, diaper holders and liners, feminine hygiene garments, and the like.

Figure 1 is a plan view of the diaper 20 of the present invention in its flat-out, uncontracted state (i.e., with elastic induced contraction pulled out except in the side panels wherein the elastic is left in its relaxed condition) with portions of the structure being cut-away to more clearly show the construction of the diaper 20 and with the portion of the diaper 20 which faces away from the wearer, the outer surface 52, facing the viewer. As shown in Figure 1, the diaper 20 comprises a containment assembly 22 preferably comprising a liquid pervious topsheet 24, a liquid impervious backsheet 26 joined with the topsheet 24, and an absorbent core 28 positioned between the topsheet 24 and the

backsheet 26; elasticized side panels 30; elasticized leg cuffs 32; elasticized waistbands 34; and a dual tension fastening system generally multiply designated as 36. The dual tension fastening system 36 comprises a primary fastening system 38 and a waist closure system 40. The primary fastening system 38 preferably comprises a pair of securement members 42 and a landing member 44. The waist closure system 40 is shown in Figure 1 to preferably comprise a pair of first attachment components 46 and a second attachment component 48. The diaper 20 also preferably comprises a positioning patch 50 located subjacent each first attachment component 46.

The diaper 20 is shown in Figure 1 to have an outer surface 52 (facing the viewer in Figure 1), an inner surface 54 opposed to the outer surface 52, a first waist region 56, a second waist region 58 opposed to the first waist region 56, and a periphery 60 which is defined by the outer edges of the diaper 20 in which the longitudinal edges are designated 62 and the end edges are designated 64. (While the skilled artisan will recognize that a diaper is usually described in terms of having a pair of waist regions and a crotch region between the waist regions; in this application, for simplicity of terminology, the diaper 20 is described as having only waist regions, each of the waist regions including a portion of the diaper which would typically be designated as part of the crotch region.) The inner surface 54 of the diaper 20 comprises that portion of the diaper 20 which is positioned adjacent to the wearer's body during use (i.e., the inner surface 54 generally is formed by at least a portion of the topsheet 24 and other components joined to the topsheet 24). The outer surface 52 comprises that portion of the diaper 20 which is positioned away from the wearer's body (i.e., the outer surface 52 generally is formed by at least a portion of the backsheet 26 and other components joined to the backsheet 26). The first waist region 56 and the second waist region 58 extend, respectively, from the end edges 64 of the periphery 60 to the lateral centerline 66 of the diaper 20. The waist regions each comprise a central region 68 and a pair of side panels which typically comprise the outer lateral portions of the waist regions. The

side panels positioned in the first waist region 56 are designated 70 while the side panels in the second waist region 58 are designated 72. (In the discussion that follows, unless otherwise noted, the diaper 20 will comprise a pair of side panels in each waist region. While it is not necessary that the pairs of side panels or each side panel be identical, they are preferably mirror images one of the other.) In a preferred embodiment of the present invention, the side panels 72 positioned in the second waist region 58 are elastically extensible in the lateral direction (i.e., elasticized side panels 30). (The lateral direction (x direction or width) is defined as the direction parallel to the lateral centerline 66 of the diaper 20; the longitudinal direction (y direction or length) being defined as the direction parallel to the longitudinal centerline 67; and the axial direction (Z direction or thickness) being defined as the direction extending through the thickness of the diaper 20.)

Figure 1 shows a preferred embodiment of the diaper 20 in which the topsheet 24 and the backsheet 26 have length and width dimensions generally larger than those of the absorbent core 28. The topsheet 24 and the backsheet 26 extend beyond the edges of the absorbent core 28 to thereby form the periphery 60 of the diaper 20. The periphery 60 defines the outer perimeter or, in other words, the edges of the diaper 20. The periphery 60 comprises the longitudinal edges 62 and the end edges 64.

Figure 2 is a cross-sectional view of the diaper 20 taken along section line 2-2 of Figure 1 in the first waist region 56. Figure 2 shows the topsheet 24 and the backsheet 26 extending laterally across the entire cross-section to form both of the longitudinal edges 62. The first attachment components 46 are disposed in the first waist region 56 so as to form a portion of the outer surface 52 and are preferably a separate patch of material joined to the backsheet 26 by an adhesive attachment means 74 for securing the first attachment components 46 to the diaper 20. As shown in Figure 2, the first attachment components 46 each preferably comprise a hook fastening material. The prongs 120 of the hook fastening material are preferably oriented so that the engaging element of each prong 120 faces toward the

longitudinal centerline 67 so as to maximize the shear strength of the hook fastening material. A positioning patch 50 is located subjacent each of the first attachment components 46, each positioning patch 50 preferably being positioned between the topsheet 24 and the backsheet 26. The elasticized waistband 34 is shown in Figure 2 in its contracted or relaxed condition. The elasticized waistband 34 preferably comprises a portion of the topsheet 24, a portion of the backsheet 26, and an elastic waistband member 76 positioned between the topsheet 24 and the backsheet 26. The elasticized waistband 34 is also provided with regions of securement 78 (preferably the discrete zones of sealing 79 partially shown in Figure 1) wherein the backsheet 26 and the topsheet 24 are joined to the elastic waistband member 76. Since the topsheet 24 and the backsheet 26 are gathered when the elastic waistband member 76 is in its relaxed condition, regions of differential securement are provided which form pleats 80. The first attachment components 46 are longitudinally aligned with the elasticized waistband 34 and laterally spaced from each other, preferably beyond the side edges 75 of the elastic waistband member 76.

Figure 3 is a fragmentary cross-sectional view of the diaper 20 taken along section line 3-3 of Figure 1 and depicts a preferred diaper construction in a portion of the central region 68 and in one of the side panels 72 of the second waist region 58. (The cross-sectional view shown in Figure 3 has been inverted so that the outer surface 52 is shown as positioned toward the bottom of the drawing.) The absorbent core 28 is generally shown in Figure 3 and shows the side edge 82 of the absorbent core 28. The topsheet 24 and the backsheet 26 encase the absorbent core 28 and extend laterally outwardly beyond the side edge 82 of the absorbent core 28 to form an ear flap 88 and the longitudinal edge 62. Figure 3 also shows a portion of the elasticized leg cuff 32 comprising an elasticized barrier cuff 84 preferably comprising a barrier flap 85 and a spacing means, spacing elastic member 86, positioned in the barrier flap 85. (The other portion of the elasticized leg cuff 32, elastic gasketing cuff 104, is not shown in Figure 3 since the elastic gasketing cuff preferably does not

extend into this portion of the diaper 20.) Figure 3 further shows the elasticized side panel 30 in its contracted or relaxed condition. The elasticized side panel comprises the ear flap 88 extending beyond the side edge 82 of the absorbent core 28, and an elastic side panel member 90 operatively associated with and joined to the ear flap 88 preferably between the topsheet 24 and the backsheet 26. The topsheet 24, the backsheet 26, and the elastic side panel member 90 have been mechanically stretched, as discussed hereinafter, to form a "zero strain" stretch laminate. The tape tab 92 of the primary fastening system 38 is shown to comprise a fixed portion 93 joined to the backsheet 26 adjacent the longitudinal edge 62, a tab portion 94 extending outwardly from the longitudinal edge 62 and joined to the fixed portion 93, a release portion 95 joined to the topsheet 24, and a first fastening component 112, preferably adhesive attachment layer 96, disposed on the the tab portion 94 to form the fastening surface 98.

The containment assembly 22 of the diaper 20 is shown in Figure 1 as comprising the main body (chassis) of the diaper 20. The containment assembly 22 comprises at least an absorbent core 28 and preferably an outer covering layer comprising the topsheet 24 and the backsheet 26. When the absorbent article comprises a separate holder and a liner, the containment assembly 22 generally comprises the holder and the liner (i.e., the containment assembly 22 comprises one or more layers of material to define the holder while the liner comprises an absorbent composite such as a topsheet, a backsheet, and an absorbent core.) For unitary absorbent articles, the containment assembly 22 comprises the main structure of the diaper with other features added to form the composite diaper structure. Thus, the containment assembly 22 for the diaper 20 generally comprises the topsheet 24, the backsheet 26, and the absorbent core 28.

The absorbent core 28 may be any absorbent means which is generally compressible, conformable, non-irritating to the wearer's skin, and capable of absorbing and retaining liquids such as urine and other certain body exudates. As shown in Figures 1

and 2, the absorbent core 28 has a garment surface 100, a body surface 101, side edges 82, and waist edges 83.

The absorbent core 28 may be manufactured in a wide variety of sizes and shapes (e.g., rectangular, hourglass, "T"-shaped, asymmetric, etc.) and from a wide variety of liquid-absorbent materials commonly used in disposable diapers and other absorbent articles such as comminuted wood pulp which is generally referred to as airfelt. Examples of other suitable absorbent materials include creped cellulose wadding, meltblown polymers including coform, cross-linked cellulosic fibers, tissue including tissue wraps, absorbent foams, absorbent sponges, superabsorbent polymers, absorbent gelling materials, or any equivalent material or combinations of materials. The configuration and construction of the absorbent core may also be varied (e.g., the absorbent core may have varying caliper zones, a hydrophilic gradient, a superabsorbent gradient, or lower average density and lower average basis weight acquisition zones; or may comprise one or more layers or structures). The total absorbent capacity of the absorbent core 28 should, however, be compatible with the design loading and the intended use of the diaper 20. Further, the size and absorbent capacity of the absorbent core 28 may be varied to accommodate wearers ranging from infants through adults.

A preferred embodiment of the diaper 20 has an asymmetric, modified T-shaped, absorbent core 28 having ears 102 in the first waist region 56 but a generally rectangular shape in the second waist region 58. This configuration allows wider elasticized side panels 30 in the second waist region 58. An exemplary absorbent structure for use as the absorbent core 28 of the present invention that has achieved wide acceptance and commercial success is described in U.S. Patent 4,610,678 entitled "High-Density Absorbent Structures" issued to Weisman and Goldman on September 9, 1986. U.S. Patent 4,673,402 entitled "Absorbent Articles With Dual-Layered Cores" issued to Weisman, Houghton, and Gellert on June 16, 1987; and U.S. Patent 4,888,231 entitled "Absorbent Core Having A Dusting Layer" issued to Angstadt on December 19, 1989; also describe absorbent structures that are useful in the present invention. The absorbent core 28 is preferably the commercially

successful absorbent member described in U.S. Patent 4,834,735, entitled "High Density Absorbent Members Having Lower Density and Lower Basis Weight Acquisition Zones", issued to Alemany and Berg on May 30, 1989. Each of these references are incorporated herein by reference.

The backsheet 26 is positioned adjacent the garment surface 100 of the absorbent core 28 and is preferably joined thereto by attachment means (not shown) such as those well known in the art. For example, the backsheet 26 may be secured to the absorbent core 28 by a uniform continuous layer of adhesive, a patterned layer of adhesive, or an array of separate lines, spirals, or spots of adhesive. Adhesives which have been found to be satisfactory are manufactured by Century Adhesives, Inc. of Columbus, Ohio and marketed as Century 5227; and by H. B. Fuller Company of St. Paul, Minnesota and marketed as HL-1258. The attachment means will preferably comprise an open pattern network of filaments of adhesive as is disclosed in U.S. Patent 4,573,986 entitled "Disposable Waste-Containment Garment", which issued to Minetola and Tucker on March 4, 1986, and which is incorporated herein by reference. An exemplary attachment means of an open pattern network of filaments comprises several lines of adhesive filaments swirled into a spiral pattern such as is illustrated by the apparatus and methods shown in U.S. Patent 3,911,173 issued to Sprague, Jr. on October 7, 1975; U.S. Patent 4,785,996 issued to Ziecker, et al. on November 22, 1978; and U.S. Patent 4,842,666 issued to Werenicz on June 27, 1989. Each of these patents are incorporated herein by reference. Alternatively, the attachment means may comprise heat bonds, pressure bonds, ultrasonic bonds, dynamic mechanical bonds, or any other suitable attachment means or combinations of these attachment means as are known in the art.

The backsheet 26 is impervious to liquids (e.g., urine) and is preferably manufactured from a thin plastic film, although other flexible liquid impervious materials may also be used. As used herein, the term "flexible" refers to materials which are compliant and will readily conform to the general shape and contours of the human body. The backsheet 26 prevents the exudates absorbed and contained in the absorbent core 28 from

wetting articles which contact the diaper 20 such as bedsheets and undergarments. The backsheet 26 may thus comprise a woven or nonwoven material, polymeric films such as thermoplastic films of polyethylene or polypropylene, or composite materials such as a film-coated nonwoven material. Preferably, the backsheet is a film having a thickness of from about 0.012 mm (0.5 mil) to about 0.051 mm (2.0 mils).

In a preferred embodiment of the present invention, at least a portion of the backsheet 26 is subjected to mechanical stretching in order to provide a "zero strain" stretch laminate that forms the elasticized side panels 30. Thus, the backsheet 26 is preferably elongatable, most preferably drawable, but not necessarily elastomeric, so that the backsheet 26 will, upon mechanical stretching, be at least to a degree permanently elongated such that it will not fully return to its original undistorted configuration. In preferred embodiments, the backsheet can be subjected to mechanical stretching without undue rupturing or tearing. Thus, it is preferred that the backsheet 26 have an ultimate elongation to break of at least about 400% to about 700% in the cross-machine direction as measured using a method consistent with ASTM D-638. Thus, preferred polymeric films for use as the backsheet contain a high content of linear low density polyethylene. Particularly preferred materials for the backsheet include blends comprised of about 45-90% linear low density polyethylene and about 10-55% polypropylene. Exemplary films for use as the backsheet of the present invention are manufactured by Tredegar Industries, Inc. of Terre Haute, Indiana under the designation RR8220 blend for blown films and RR5475 blend for cast films. The backsheet 26 is preferably embossed (typically, to a caliper of about 0.127 mm (5.5 mils)) and/or matte finished to provide a more clothlike appearance. Further, the backsheet 26 may permit vapors to escape from the absorbent core 28 (i.e., breathable) while still preventing exudates from passing through the backsheet 26.

The size of the backsheet 26 is dictated by the size of the absorbent core 28 and the exact diaper design selected. In a preferred embodiment, the backsheet 26 has a modified hourglass

shape extending beyond the absorbent core 28 a minimum distance of at least about 1.3 cm to about 2.5 cm (about 0.5 to about 1.0 inch) around the entire diaper periphery 60. Preferably, the backsheet 26 is much wider than the absorbent core 28 in the second waist region 58 so that the side panels 72 in the second waist region 58 are generally wider in the lateral direction than the side panels 70 in the first waist region 56.

The topsheet 24 is positioned adjacent the body surface 101 of the absorbent core 28 and is preferably joined thereto and to the backsheet 26 by attachment means (not shown) such as those well known in the art. Suitable attachment means are described with respect to joining the backsheet 26 to the absorbent core 28. As used herein, the term "joined" encompasses configurations whereby an element is directly secured to the other element by affixing the element directly to the other element, and configurations whereby the element is indirectly secured to the other element by affixing the element to intermediate member(s) which in turn are affixed to the other element. In a preferred embodiment of the present invention, the topsheet 24 and the backsheet 26 are joined directly to each other in the diaper periphery 60 and are indirectly joined together by directly joining them to the absorbent core 28 by the attachment means (not shown).

The topsheet 24 is compliant, soft feeling, and non-irritating to the wearer's skin. Further, the topsheet 24 is liquid pervious permitting liquids (e.g., urine) to readily penetrate through its thickness. A suitable topsheet may be manufactured from a wide range of materials, such as porous foams; reticulated foams; apertured plastic films; or woven or nonwoven webs of natural fibers (e.g., wood or cotton fibers), synthetic fibers (e.g., polyester or polypropylene fibers), or a combination of natural and synthetic fibers. Preferably, the topsheet 24 is made of a hydrophobic material to isolate the wearer's skin from liquids contained in the absorbent core 28.

In a preferred embodiment of the present invention, at least a portion of the topsheet 24 is subjected to mechanical stretching in order to provide a "zero strain" stretch laminate that forms

the elasticized side panels 30. Thus, the topsheet 24 is preferably elongatable, most preferably drawable, but not necessarily elastomeric, so that the topsheet 24 will, upon mechanical stretching, be at least to a degree permanently elongated such that it will not fully return to its original configuration. In preferred embodiments, the topsheet 24 can be subjected to mechanical stretching without undue rupturing or tearing of the topsheet. Thus, it is preferred that the topsheet 24 have a low cross-machine direction (lateral direction) yield strength.

There are a number of manufacturing techniques which may be used to manufacture the topsheet 24. For example, the topsheet 24 may be a nonwoven web of fibers. When the topsheet comprises a nonwoven web, the web may be spunbonded, carded, wet-laid, meltblown, hydroentangled, combinations of the above, or the like. A preferred topsheet is carded and thermally bonded by means well known to those skilled in the fabrics art. A preferred topsheet comprises staple length polypropylene fibers having a denier of about 2.2. As used herein, the term "staple length fibers" refers to those fibers having a length of at least about 15.9 mm (0.625 inches). Preferably, the topsheet has a basis weight from about 18 to about 25 grams per square meter. A suitable topsheet is manufactured by Veratec, Inc., a Division of International Paper Company, of Walpole, Massachusetts under the designation P-8.

The diaper 20 preferably further comprises elasticized leg cuffs 32 for providing improved containment of liquids and other body exudates. Each elasticized leg cuff 32 may comprise several different embodiments for reducing the leakage of body exudates in the leg regions. (The leg cuff can be and is sometimes also referred to as leg bands, side flaps, barrier cuffs, or elastic cuffs.) U.S. Patent 3,860,003 entitled "Contractable Side Portions For a Disposable Diaper" issued to Buell on January 14, 1975, describes a disposable diaper which provides a contractible leg opening having a side flap and one or more elastic members to provide an elasticized leg cuff (gasketing cuff). U.S. Patent 4,909,803 entitled "Disposable Absorbent Article Having Elasticized Flaps" issued to Aziz and Blaney on March 20, 1990,

describes a disposable diaper having "stand-up" elasticized flaps (barrier cuffs) to improve the containment of the leg regions. U.S. Patent 4,695,278 entitled "Absorbent Article Having Dual Cuffs" issued to Lawson on September 22, 1987, describes a disposable diaper having dual cuffs including a gasketing cuff and a barrier cuff. U.S. Patent 4,704,115 entitled "Disposable Waist Containment Garment" issued to Buell on November 3, 1987, discloses a disposable diaper or incontinent garment having side-edge-leakage-guard gutters configured to contain free liquids within the garment. Each of these patents are incorporated herein by reference. While each elasticized leg cuff 32 may be configured so as to be similar to any of the leg bands, side flaps, barrier cuffs, or elastic cuffs described above, as shown in Figure 1 and Figure 3, it is preferred that each elasticized leg cuff 32 comprise at least an inner barrier cuff 84 comprising a barrier flap 85 and a spacing elastic member 86 such as described in the above-referenced U.S. Patent 4,909,803. In a preferred embodiment as shown in Figure 1, the elasticized leg cuff 32 additionally comprises an elastic gasketing cuff 104 with one or more elastic strands 105, positioned outboard of the barrier cuff 84 such as described in the above-referenced U.S. Patent 4,695,278.

The diaper 20 further comprises an elasticized waistband 34 disposed adjacent the end edge 64 of the diaper 20 in the first waist region 56. The waistband of the diaper 20 is that portion which is intended to be placed adjacent the wearer's waist. The elasticized waistband 34 provides a member that maintains a defined area coverage, contacts the wearer's waist, and is elastically extensible in at least the lateral direction so as to dynamically fit against the waist of the wearer and to dynamically conform to the waist of the wearer so as to provide improved fit. Thus, the waistband is generally that portion of the diaper 20 extending from the end edge 64 of the diaper 20 to at least the waist edge 83 of the absorbent core 28. While the elasticized waistband 34 can comprise a separate element affixed to the containment assembly 22 of the diaper 20, the waistband is preferably an extension of other elements of the diaper 20 such as

the topsheet 24 or the backsheet 26 or both and an elastomeric material joined thereto. Disposable diapers are often constructed so as to have two elasticized waistbands; one positioned in the first waist region 56 and one positioned in the second waist region 58. As discussed herein, the diaper 20 at least has an elasticized waistband 34 disposed in at least the central region 68 of the first waist region 56. Preferably, as shown in Figure 1, another elasticized waistband is disposed in the second waist region 58, preferably between the elasticized side panels 30.

The elasticized waistband 34 may be constructed in a number of different configurations including those described herein with regard to the elasticized side panels. In a preferred embodiment of the present invention shown in Figure 1, the elasticized waistband 34 comprises an elastic waistband member 76 interposed between the topsheet 24 and the backsheet 26 and operatively associated with either or both the topsheet 24 and the backsheet 26 to gather the first waist region 56 of the diaper 20. An example of such an elasticized waistband for use herein is the elasticized waistband disclosed in U.S. Patent 4,515,595 entitled "Disposable Diapers With Elastically Contractible Waistbands", which issued to Kievit and Osterhage on May 7, 1985, and which patent is incorporated herein by reference. Any suitable elastomeric material as known in the art may be used as the elastic waistband member 76 of the present invention. Examples of suitable elastomeric materials include elastomeric films, elastomeric foams such as polyurethane foams or crosslinked natural rubber foams; formed elastic scrim; elastomeric films such as heat shrinkable elastic materials; elastomeric film laminates such as a laminate of a heat-shrinkable elastomeric film and a resilient member; elastomeric stretch laminates such as "zero strain" stretch laminates as described hereinafter or mechanically stretched pretensioned stretch laminates; and elastic strands made from rubber, LYCRA, or other materials. In a preferred embodiment, the elastic waistband member 76 comprises an elastomeric foam such as is described herein for use in the elasticized side panels 30. Other embodiments of preferred constructions for the elasticized waistband are the elastic waist

features described in commonly assigned, co-pending, U.S. Patent Application, P&G Case 4413, Buell et al., "Absorbent Article With Dynamic Elastic Waist Feature Having A Predisposed Resilient Flexural Hinge", filed concurrently herewith; the specification and drawings of which are incorporated herein by reference.

In an alternative embodiment, the elasticized waistband in the second waist region 58 (or in the first waist region 56 if elasticized side panels are disposed therein) and the elasticized side panels 30 can be formed by securing a single piece of elastomeric material to the diaper 20 in both the side panels 72 and the central region 68 of the second waist region 58. Thus, the elasticized waistband 34 and the elasticized side panels 30 can be formed from the same piece of material to form a unitary structure. An example of such an elasticized waistband/side panel configuration is disclosed in the hereinbefore referenced U.S. Patent 4,887,067 issued to Wood, et al. on August 15, 1989, and which patent is incorporated herein by reference.

In a further alternative embodiment of the present invention, the elasticized waistband 34 may have differential extensibility along the longitudinal axis when stretched in the lateral direction. The differential extensibility of the elasticized waistband 34 allows portions to laterally expand to a greater degree than other portions along the longitudinal axis. This differential extensibility of the elasticized waistband provides an abdominally compliant elasticized waistband, "expansive tummy panel", that allows the elasticized waistband to differentially shape, expand and move with the stomach of the wearer as the wearer moves, sits, and stands. Differential extensibility along the longitudinal axis when stretched in the lateral direction of the elasticized waistband can be achieved in a number of ways such as is discussed herein with respect to the elasticized side panels 30. As shown in Figure 5, a preferred differential extensibility elasticized waistband has a "pentagonal" shape. In this embodiment, the waistband shape is formed by corrugating rolls with straining elements having the shape of the desired waistband shape.

The diaper 20 is further provided with a dual tension fastening system 36 for forming both a side closure and a waist closure. The dual tension fastening system 36 comprises a primary fastening system 38 for providing the side closure and a waist closure system 40 for providing the waist closure. The primary fastening system 38 maintains the first waist region 56 and the second waist region 58 in an overlapping configuration such that lateral tensions are maintained around the circumference of the diaper to maintain the diaper on the wearer. The waist closure system 40 forms a waist closure that dynamically maintains/creates lateral tensions through the elasticized waistband 34 so as to improve the fit and containment characteristics of the diaper 20 by reducing gapping, sagging, and rollover of the elasticized waistband 34.

As shown in Figure 1, the primary fastening system 38 comprises a securement member 42 disposed adjacent each longitudinal edge 62 in the second waist region 58, and at least one landing member 44 disposed in the first waist region 56 so as to form a portion of the outer surface 52. Each securement member 42 preferably comprises a tape tab 92 and a first fastening component 112. The landing member 44 preferably comprises a complementary second fastening component 114 engageable with the first fastening component 112 of the securement member 42. An exemplary primary fastening system wherein the first and second fastening components each comprise mechanical closure elements comprising hook and loop fastening materials is disclosed in U.S. Patent 4,869,724 entitled "Mechanical Fastening Systems With Adhesive Tape Disposal Means For Disposable Absorbent Articles" issued to Scripps on September 26, 1989. Primary fastening systems utilizing mechanical closure elements are also disclosed in U.S. Patent 4,846,815 entitled "Disposable Diaper Having An Improved Fastening Device" issued to Scripps on July 11, 1989; and U.S. Patent 4,894,060 entitled "Disposable Diaper With Improved Hook Fastener Portion" issued to Nestegard on January 16, 1990. A primary fastening system having combination adhesive/mechanical closure elements is described in U.S. Patent 4,946,527 entitled "Pressure-Sensitive Adhesive Fastener And Method of Making Same"

issued to Battrell on August 7, 1990. Each of these patents are incorporated herein by reference. In a preferred embodiment of the present invention as is shown in Figure 1, the primary fastening system 38 comprises an adhesive tape tab fastening system comprising a tape tab 92 having an adhesive attachment layer 96 and a landing member 44 comprising a reinforcing strip 116 joined to the backsheet 26. Examples of such adhesive tape tab fastening systems are disclosed in U.S. Patent 3,848,594 entitled "Tape Fastening System for Disposable Diaper" issued to Buell on November 19, 1974; and the adhesive tape tabs, reinforcing strip, and indicia means disclosed in U.S. Patent Bl 4,662,875 entitled "Absorbent Article" issued to Hirotsu and Robertson on May 5, 1987. Each of these patents are incorporated herein by reference.

Each securement member 42 of the primary fastening system 38 is intended to provide a fastening means for engaging the landing member 44 so as to provide a secure, preferably a variable positioning, side closure for the diaper 20. Thus, the securement member 42 comprises at least one fastening component. Each securement member 42 also preferably comprises a means for positioning the fastening component adjacent the landing member 44 so as to achieve an optimum fitting side closure. Thus, the securement member 42 may comprise any of the well known configurations and means for achieving a side closure on a diaper such as (i) a patch or strip of a fastening component disposed to form a portion of the inner surface of the diaper or (ii) a tape tab having a fastening component positioned thereon.

As shown in Figure 1, each securement member 42 preferably comprises a tape tab 92. Any of the well known configurations and constructions of a tape tab may be used in the present invention. For example, an exemplary tape tab is described in detail in the hereinbefore referenced U.S. Patent 3,848,594 issued to Buell on November 19, 1974, and which patent is incorporated herein by reference. A particularly preferred tape tab 92 is illustrated in Figure 3 and has a fastening surface 98 and a backing surface 99. The fastening surface 98 is that surface of the tape tab 92 designed to engage the landing member 44 of the present invention.

Thus, the fastening surface 98 of the tape tab 92 is generally oriented to face the inner surface 54 of the diaper 20. The backing surface 99 is that surface opposed to the fastening surface 98 and generally faces the outer surface 52 of the diaper 20. The backing surface 99 is thus generally exposed during wear of the diaper 20.

The preferred tape tab 92 illustrated in Figure 3 is one which is joined to the backsheet 26 of the diaper 20 to create a fixed portion 93 (i.e., that end of the tape tab 92 joined to the diaper 20 during manufacture). The tape tab 92 has another element which is the tab portion 94 (i.e., that end of the tape tab 92 that extends outwardly beyond the longitudinal edge 62 of the diaper 20 and that is grasped by the diaperer in securing the diaper on the wearer). The distal edge 97 of the tape tab 92 preferably has rounded corners to eliminate the possibility of harsh corner edges contacting the wearer's skin so as to prevent stomach redmarking. The preferred tape tab 92 of the present invention also comprises a release portion 95 joined to the topsheet 24 of the diaper 20. The release portion 95 allows the tab portion 94 to be inwardly folded during manufacture to protect the adhesive attachment layer 96 from contamination or delamination prior to use. As shown in Figure 3, the release portion 95 extends inwardly from the longitudinal edge 62 of the diaper 20 preferably up to and juxtaposed over a portion of the elastic side panel member 90 so that the load carried by the tape tab 92 is transferred into the elastic side panel member 90 resulting in more effective distribution of the loads (wearing stresses). The tab portion 94 is also preferably shorter in the lateral direction (width) than the release portion 95 so that it is easier for the diaperer to initially grasp the tab portion 94.

The fastening component of the securement member 42 forms the closure between the securement member 42 and the complementary fastening component of the landing member 44. Thus, the fastening component provides a means for engaging the complementary fastening component of the landing member 44 to maintain the first waist region 56 and the second waist region 58 in an overlapping configuration to provide a secure side closure for the diaper 20.

Further, it is preferred that a diaper fit a range of different size wearers and that the fastening system be simple and easy to use. Therefore, the fastening components should allow for variable positioning of the zone of closure so that the diaper may fit a range of sizes while also being simple to fasten with minimal effort. The fastening components thus comprise any of the well known attachment means for achieving an adjustable positioning secure closure as defined hereinafter. Examples of such adjustable positioning attachment means include an adhesive attachment layer such as a pressure-sensitive adhesive as are known in the art, a mechanical closure element such as a hook fastening material or a loop fastening material, any cohesive materials as are known in the art, or a combination of an adhesive/mechanical closure element, as hereinafter described with respect to the waist closure system 40.

The fastening component is disposed on the securement member 42 such that it may be a separate member joined to and associated with the securement member 42 or a unitary member with the securement member 42. For example, the topsheet 24 or the backsheet 26 may be manufactured from a material that mechanically engages the landing member 44 (the topsheet 24 or the backsheet 26 being a unitary fastening component). Alternatively, a discrete patch or strip of material may be joined to the securement member 42 (a separate fastening component). Preferably, the first fastening component 112 is a separate material, such as an adhesive attachment layer or a mechanical closure element, positioned on and joined to the tape tab 92. As shown in Figure 3, the first fastening component 112 preferably comprises an adhesive attachment layer 96 coated on the tab portion 94 to form the fastening surface 98.

In addition, the first fastening component 112 may be positioned anywhere on the securement member 42. For example, the first fastening component 112 may be positioned in the side panels 72 of the second waist region 58 adjacent the longitudinal edges 62. (Exemplary examples of this construction are shown in U.S. Patent 4,610,682 issued to Kopp on September 9, 1986; and in U.S. Patent 3,141,161 issued to Farris on July 21, 1964; each of which

are incorporated herein by reference.) When the securement member 42 comprises a tape tab 92, the first fastening component 112 is preferably positioned either on all of or at least a portion of the fastening surface 98 of the tab portion 94. The first fastening component 112 may comprise a combination adhesive/mechanical closure element having an adhesive attachment layer and a mechanical closure element disposed on another area of the tab portion 94 on the fastening surface 98 and adjacent the distal edge 97 of the tape tab 92. An exemplary embodiment of this configuration is disclosed in the hereinbefore referenced U.S. Patent 4,869,724 entitled "Mechanical Fastening Systems With Adhesive Tape Disposal Means For Disposable Absorbent Article" issued to Scripps on September 26, 1989, which is incorporated herein by reference.

The landing member 44 of the primary fastening system 38 provides a means for securing itself to the securement member 42 to provide a side closure and to maintain the first waist region 56 and the second waist region 58 in an overlapping configuration. The landing member 44 may be disposed anywhere on the diaper 20 so long as it can engage the securement member 42 so as to provide the side closure and, preferably a variable positioning side closure. For example, the landing member 44 may be disposed so as to form a portion of the outer surface 52 in the first waist region 56, so as to form a portion of the inner surface 54 in the second waist region 58, or on any other portion or element of the diaper 20 which is disposed to engage the securement member 42. Because the landing member 44 determines the approximate location of where the securement member 42 should be placed for optimum fit, the landing member 44 is preferably positioned so as to achieve variable positioning of the side closure so that the diaper may fit a range of sizes, so that an overlap between the first waist region 56 and the second waist region 58 is achieved, and so that when the side closure is formed the attachment components of the waist closure system 40 engage each other such that the formation of the side closure also passively forms the waist closure. The landing member 44 is preferably centered about

the longitudinal centerline 67 in the first waist region 56 and extends laterally outwardly to almost the longitudinal edges 62.

The landing member 44 may either be a discrete, separate element or elements joined to the diaper 20 or a unitary piece of material with an element of the diaper 20. The landing member 44 may thus comprise, for example, the topsheet 24 or the backsheet 26. While the landing member 44 can assume varying sizes and shapes, it preferably comprises one or more patches of material joined to the backsheet 26 in the first waist region 56 that allows for maximum fit adjustment of diaper 20 to the wearer. In a preferred embodiment of the diaper 20 as illustrated in Figure 1, the landing member 44 has an elongate, rectangular-shape and is secured to the backsheet 26 in the central region 68 of the first waist region 56 by an adhesive attachment means (not shown) as have been previously discussed. The landing member 44 comprises a fastening component (second fastening component 114) engageable with the fastening component of the securement member 42 (first fastening component 112). Thus, the fastening component of the landing member 44 (second fastening component 114) may be manufactured from a wide range of materials and configurations capable of securely engaging the fastening component of the securement member 42 (first fastening component 112).

When the first fastening component 112 of the securement member 42 comprises an adhesive attachment layer 96, the second fastening component 114 of the landing member 44 preferably comprises a reinforcing strip 116 and/or the backsheet 26. When the first fastening component 112 of the securement member 42 comprises a mechanical closure element, the second fastening component 114 also comprises a mechanical closure element. Thus, when the first fastening component 112 comprises a hook fastening material, the second fastening component 114 preferably comprises a loop fastening material.

In a preferred embodiment of the present invention as shown in Figure 1, the landing member 44 preferably comprises a reinforcing strip 116 releasably engageable with the adhesive attachment layer 96 of the tape tabs 92. The reinforcing strip 116 may comprise any of a number of configurations and materials

secured to the backsheet 26 of the diaper 20. The reinforcing strip 116 is preferably a separate member secured to the backsheet 26 to form a portion of the outer surface 52 of the diaper 20. A preferred reinforcing strip 116 comprises a sheet of biaxially oriented polypropylene film.

The reinforcing strip 116 is also preferably provided with indicia means 118 for aiding the diaperer in fitting the diaper to a wearer to obtain optimal waist fit and leg opening fit. The indicia means 118 may be any type of lines, patterns, ornamental designs, symbols, script, color codes, or other markings which have the capability, either inherently or with additional denotation, to aid an individual fitting the diaper to the wearer to promptly locate the desired affixation points for a particular tape tab fastener. Such indicia means 118 are more fully described in U.S. Patent Bl 4,662,875 entitled "Absorbent Article" which issued to Hirotsu and Robertson on May 5, 1987 and which is incorporated herein by reference. Indicia means of the present invention are preferably a combination of different geometric shapes, colors, and objects such as SESAME STREET or DISNEY characters.

The dual tension fastening system 36 additionally comprises a waist closure system 40 for providing a waist closure adjacent the end edge 64 of the diaper 20. The waist closure anchors a portion of the span of the end edge 64. Further, when the diaper 20 comprises an elasticized waistband 34, the waist closure dynamically creates/maintains lateral tensions through the elasticized waistband 34.

The waist closure anchors a portion of the span of the end edge 64 of the diaper 20, preferably a portion of the extensible span of the elasticized waistband 34. (i.e., The first and second attachment components of the waist closure system 40 act to anchor the positional relationship of the elasticized waistband 34 with the elasticized side panels 30.) The term "anchor" is used herein to mean that the attachment components provide an adjustable positioning fastener that achieves a closure with sufficient shear resistance so that there is little or no shear slippage or movement between the attachment components once the closure is

achieved. The positional relationship of the elasticized waistband 34 with the elasticized side panels 30 (i.e., the geometric relationship between the anchor zones of the first attachment components 46) establishes a defined waist circumferential dimension adjacent the end edge 64 of the diaper 20 which is distinct (longitudinally spaced) from the circumferential dimension established by the side closure formed by the primary fastening system 38. This distinct, defined waist circumferential dimension creates/maintains the required fit dimension(s) at the upper extremities (adjacent the end edge 64) of the diaper 20. Thus, the waist closure system 40 of the present invention can also be beneficial for use on diapers not employing an elasticized waistband (e.g., a waistshield or a nonextensible waist feature) so as to maintain a nonextensible fit at the end edge 64 (upper edge) of the diaper 20. The anchoring also provides a means for transferring shear forces (tensions) between the elasticized waistband 34 and the elasticized side panels 30 so as to enhance the initial pretension created within the elasticized waistband 34.

The waist closure also creates/maintains lateral tension(s) through the elasticized waistband 34. The waist closure contributes some portion of an initial pretension (lateral tension) within the elasticized waistband 34 that allows the elasticized waistband 34 to snugly fit against the wearer's waist when initially fitted. The elasticized waistband 34 maintains, during use, some portion of the pretension created within it by the waist closure. Since the elasticized waistband maintains some portion of the pretension created within it, the elasticized waistband can repeatedly elastically expand or contract with the motions of the wearer so as to snugly sustain the fit of the diaper against the wearer's waist throughout use. In particular, during wearing conditions, the elasticized waistband, in order to follow the movements of the wearer's waist, may have to contract to its untensioned state (i.e., the pretension goes to zero); however, because the attachment components remain engaged, the pretension will be reestablished within the elasticized waistband with further movement and activity by the wearer. (This is in

contrast to most conventional elasticized waistbands that are not pretensioned such as to not be able to further contract to dynamically fit the wearer.) This initial pretensioning and maintenance of the tension thus results in reduced gapping and better sustained fit of the elasticized waistband. Further, the lateral tension(s) created/maintained by the waist closure provide restoring forces within the elasticized waistband that reduce or counteract the incidence of waistband "rollover". Thus, the waist closure system 40 provides a closure about the waist of the wearer to improve the initial and dynamic fit and containment characteristics of the diaper in the waist regions.

As shown in Figure 1, the waist closure system 40 comprises at least one, preferably a pair of, first attachment component(s) 46 and at least one second attachment component 48. As shown in Figure 1, the first attachment component(s) 46 are longitudinally aligned with the elasticized waistband 34 so that the lateral tensions dynamically created/maintained by the waist closure system 40 extends in and through the elasticized waistband 34 during use. Further, the attachment components of the waist closure system 40 are longitudinally spaced from the securement members 42 and the landing member 44 of the primary fastening system 38 to provide a distinct, defined waist circumferential dimension for the diaper and two distinct zones of lateral tension(s). The zone of tension created by the primary fastening system 38 secures the garment on the wearer while the zone of tension dynamically created/maintained by the waist closure system 40 dynamically maintains the upper waist closure during wear.

At least two anchor zones 122 are created by the attachment components when the waist closure is formed. These two anchor zones 122 are laterally spaced from each other with all or at least a portion of the elasticized waistband 34 positioned between the anchor zones 122. The lateral spacing of these anchor zones can be achieved in a number of different ways. For example, the lateral spacing between the anchor zones 122 can be fixed by providing the waist closure system 40 with a pair of first attachment components 46 laterally spaced from each other and a second attachment component(s) 48 that allows adjustable

positioning with the first attachment components 46 (e.g., the second attachment component(s) is relatively wide). In this embodiment, since the lateral spacing of the first attachment components 46 is fixed, the lateral spacing of the first attachment components 46 determines and sets the lateral spacing of the anchor zones. In an alternative embodiment, the waist closure system 40 may comprise a pair of second attachment components 48 laterally spaced from each other and a first attachment component(s) 46 that allows adjustable positioning with the second attachment components 48 (e.g., the first attachment component 46 is relatively wide). In this embodiment, the lateral spacing of the anchor zones is determined by the size of the waist of the wearer and the overall dimension/shape of the diaper since the location of where the second attachment components 48 engage the first attachment component(s) 46 depends upon the overlap of the side panels in the second waist region 58 with the side panels in the first waist region 56.

The preferred lateral spacing of the anchor zones 122 is designed to allow passive activation of the waist closure when the side closure is formed, and to assure the maintenance of normal forces applied to the waist of the wearer to decrease the tendency of the elasticized waistband 34 to nonrecoverably rollover while providing an effective amount of stretch in the elasticized waistband that improves the fit and containment of the diaper in the waist. In order to maintain normal forces within the elasticized waistband that provide for recovery of the waistband and minimize flipping out of the tensioned waistband (i.e., nonrecoverable rollover), the lateral spacing of the anchor zones would desirably be kept to a minimum. However, in order to provide a maximum amount of stretch in the elasticized waistband, the lateral spacing of the anchor zones would be desirably chosen to be at a maximum. Therefore, the lateral spacing of the anchor zones is thus chosen so as to balance the need for maintaining the normal forces with the need for providing an effective amount of stretch in the elasticized waistband.

In the diaper embodiment shown in Figure 1 that is designed to fit medium-size (5.4 kg to about 10.8 kg) babies, the lateral

spacing between the anchor zones 122 (between the first attachment components 46) is at least about 25 mm. More preferably, the lateral spacing is at least about 50 mm. In the embodiment shown in Figure 1, the lateral spacing of the first attachment components 46 is most preferably between about 100 mm and about 200 mm. The lateral spacing of the anchor zones 122 is determined by measuring the distance from the innermost line of securement (i.e., that line closest to the longitudinal centerline 67) of one anchor zone to the innermost line of securement of the other anchor zone with the elasticized waistband in its contracted state. Thus, in the embodiment illustrated in Figure 1, the lateral spacing is determined by measuring the distance from the innermost edge of one of the first attachment components 46 to the innermost edge of the other first attachment component 46.

Each attachment component comprises a fastening means that engages a complementary fastening means for providing a variable positioning, passively activated, waist closure. As used herein, the term "variable positioning" closure refers to a fastening system wherein at least one of the positions of the components can widely vary so as to allow the user to form a closure at a number of different locations. Thus, for example, one of the components may have a fixed location on the diaper (e.g., the lateral spacing between the first attachment components 46 is fixed so as to provide for the pretensioning of the elasticized waistband 34 and the passive activation of the waist closure) while the other component allows for variable locations of attachment to the fixed component. This is in contrast to a "fixed" positioning closure which requires both of the mating elements to be fixed in position such that the components must be joined at a specific location each time the closure is formed (e.g., snaps and buckles). The waist closure system 40 also provides a passively activated waist closure. By "passively activated", it is meant that a functional waist closure is achieved with little or no additional effort by the diaperer after a suitable initial body/leg fit (side closure) is achieved using the primary fastening system 38. Passive activation of the waist closure system 40 requires the attachment components to not only engage each other so as to provide a secure

anchor with little or no additional effort but also to be positioned on the diaper in an arrangement that creates/maintains the lateral tensions within the elasticized waistband 34.

As shown in Figure 1, the attachment components preferably comprise mechanical closure elements. As used herein, the term "mechanical closure elements" describes fastening means which mechanically engage each other for providing a variable-position closure. Thus, the mechanical closure elements may comprise any of the well known means for achieving a variable-position closure by mechanical engagement such as VELCRO or other hook and loop fastening materials.

When the first attachment component 46 comprises a mechanical closure element, the second attachment component 48 may comprise "identical" complementary mechanical closure elements or "distinct" complementary mechanical closure elements. As used herein, the term "identical" complementary mechanical closure elements is used to define mechanical fastening systems wherein the engaging elements of the first component and the second component comprise the same configuration or structure that are interlocking. Examples of such systems are described in U.S. Patent 4,322,875 entitled "Two Strip Materials Used For Forming Fasteners" issued to Brown, et al. on April 16, 1982. The term "distinct" complementary mechanical closure elements is used herein to define mechanical fastening systems wherein the first component is different from the second component but is engageable therewith such as a hook fastening material and a loop fastening material. For example, if the second attachment component 48 comprises a loop fastening material then the first attachment component 46 will comprise a hook fastening material and vice versa.

As used herein, the term "hook fastening material" is used to designate a material having engaging elements. Thus, the hook fastening material may also be referred to as a male fastener. It should also be understood that the use of the term "hook" should be non-limiting in the sense that the engaging elements may comprise any shapes as are known in the art so long as they are

adapted to engage a complementary mechanical closure element such as a loop fastening material or another hook fastening material.

The hook fastening material is preferably intended to mechanically engage fibrous elements of a loop fastening material so as to provide a secure closure. Thus, a hook fastening material according to the present invention may be manufactured from a wide range of materials. Suitable materials include nylon, polyester, polypropylene, or any combination of these materials, or other materials as are known in the art. A suitable hook fastening material comprises a number of shaped engaging elements projecting from a backing such as the commercially available material designated "Scotchmate" brand No. FJ3402 available from Minnesota Mining and Manufacturing Company, St. Paul, Minnesota. Alternatively, the engaging elements may have any shape such as hooks, "T's", mushrooms, or any other shape as are well known in the art. An exemplary hook fastening material is described in U.S. Patent 4,846,815 entitled "Disposable Diaper Having An Improved Fastening Device" issued to Scripps on July 11, 1989, and which patent is incorporated herein by reference.

An especially preferred hook fastening material, as shown in Figures 1 and 3, comprises an array of prongs 120 formed of thermoplastic material. Hot melt adhesive thermoplastics, in particular polyester and polyamide hot melt adhesives, are particularly well suited for forming the prongs of the hook fastening material. The prongs 120 are preferably manufactured using a modified gravure printing process by printing the thermoplastic material in its molten state onto a substrate in discrete units, severing the material in a manner that allows stretching of a portion of the thermoplastic material prior to severance, and allowing the stretched molten material to "freeze" resulting in prongs. This preferred hook fastening material and methods and apparatus for making such a hook fastening material are more fully detailed in European Patent Application 0 381 087; The Procter & Gamble Company; published August 8, 1990, which application is incorporated herein by reference.

A loop fastening material provides a plurality of fibrous elements that engage the engaging elements of a hook fastening material. The loop fastening material may be manufactured from a wide range of materials to provide fibrous elements, preferably loops. Such suitable materials include nylon, polyester, polypropylene, any combination of these materials, or other materials as are known in the art. A suitable loop fastening material comprises a number of fiber loops projecting from a backing such as the commercially available material designated "Scotchmate" brand nylon woven loop No. SJ3401 available from Minnesota Mining and Manufacturing Company, St. Paul, Minnesota. Another commercially available loop fastening material comprises a tricot knit fabric having a plurality of nylon filament loops projecting from a backing of nylon such as the commercially available material designated "Guilford No. 16110" available from Guilford Mills of Greensboro, North Carolina. An exemplary inexpensive loop fastening material and a method of making such a loop fastening material are described in European Patent Application 0 289 198; The Procter & Gamble Company, published November 2, 1988, which application is incorporated herein by reference. A suitable loop fastening material may also be a woven or nonwoven fabric or any other type of fibrous material or loop material which are well known in the art. Examples of nonwoven materials suitable for use as a loop fastening material herein are discussed with respect to the materials useful as the topsheet 24 of the diaper 20. In a preferred embodiment, the loop fastening material is formed by the nonwoven material of the topsheet 24.

The attachment components may alternatively comprise an adhesive attachment layer (a layer of adhesive material). Adhesives useful in the present invention are preferably pressure-sensitive adhesives formulated to adhere to a surface at ambient temperature by applying only light pressure. Particularly preferred adhesives for use herein as the adhesive attachment layer are hot melt pressure-sensitive adhesives as are known in the art. An exemplary hot-melt pressure-sensitive adhesive is a Kraton based adhesive with tacifiers and other additives such as

marketed by Findley Adhesives, Inc. of Elm Grove, Wisconsin under the tradename Findley 990 or H-2085.

The attachment components may further comprise a combination adhesive/mechanical closure element. For example, the attachment components may comprise a combination fastener such as hook fastening material and an adhesive attachment layer juxtaposed with the hook fastening material or a mechanical closure element such as a hook fastening material having a layer of adhesive coated over a portion of the hook fastening material. An exemplary fastener having a combination mechanical/adhesive system is the pressure-sensitive adhesive fastener having a textured fastening surface such as is disclosed in U.S. Patent 4,946,527 issued to Battrell on August 7, 1990, which patent is incorporated herein by reference.

The attachment components may alternatively further comprise any other cohesive material or materials that are known in the art for providing a variable positioning fastener capable of being passively activated. For example, a cohesive strip or material can be foams, rubbers such as crepe or latex rubbers, other adhesives, or a high static vinyl material. A separable fastener of a high static vinyl material is more fully described in U.S. Patent 4,979,613 issued to McLaughlin & Kleinsmith on December 25, 1990, which patent is incorporated herein by reference.

The attachment components may comprise a separate element joined to the diaper 20 or may be a unitary element with one of the other components of the diaper. For example, the topsheet 24 may be manufactured from a material (e.g., a nonwoven web), that is capable of mechanically engaging the other attachment component (e.g., a hook fastening material). Further, the backsheet 26 can be formed from a web having a textured pattern with a layer of adhesive coated over a portion of the backsheet surface to form a combination mechanical/adhesive fastener (attachment component) such as is shown in the hereinbefore referenced U.S. Patent 4,946,527 to Battrell. In each of these cases, the attachment component is unitary with another component of the diaper. Alternatively, the attachment component may comprise a discrete strip or patch joined to the diaper. In a preferred embodiment

shown in Figure 1, each first attachment component 46 comprises a discrete separate patch of a hook fastening material joined to the backsheet 26 so as to form a portion of the outer surface 52 while the second attachment component 48 is a unitary element comprising a portion of the topsheet 24 in the second waist region 58.

In a particularly preferred embodiment of a medium sized diaper, such as the diaper 20 shown in Figure 1, the waist closure system 40 preferably comprises a pair of first attachment components 46. Each first attachment component 46 comprises an about 12 mm wide (i.e., generally perpendicular to the longitudinal centerline 67) by about 19 mm patch of a hook fastening material. The first attachment components 46 are preferably positioned so as to have a lateral spacing of about 171 mm. Each first attachment component 46 is also spaced longitudinally from the end edge 64. If the longitudinal spacing of the first attachment component (measured from the end edge of the diaper to the closest edge of the first attachment component) is too small, the first attachment component may be too high on the diaper and be in a position to contact the wearer's skin; if the longitudinal spacing is too great, the first attachment component may be so low as to allow some rollover of the elasticized waistband. The first attachment components are preferably spaced from about 3 mm (1/8 inch) to about 15 mm (5/8 inch) from the end edge of the diaper, preferably about 6 mm (1/4 inch). The hook fastening material used for the first attachment components 46 preferably comprises an array of thermoplastic prongs 120 formed on a backing; the prongs 120 of each hook fastening material most preferably being oriented with the engaging means facing inward toward the longitudinal centerline 67 of the diaper 20. The waist closure system 40 also comprises a single second attachment component 48 comprising a loop fastening material formed by a portion of the nonwoven material of the topsheet 24.

The diaper 20 additionally comprises a positioning patch 50 located subjacent the first attachment component 46. The positioning patch 50 raises the first attachment component 46 in the Z direction (thickness) to allow the first attachment

component 46 to come in better contact with the second attachment component 48 and allow the waist closure system to more easily be closed (with less effort). Thus, the waist closure system 40 is more effectively passively activated. The positioning patch 50 also provides a zone of increased flexural stiffness that reduces the tendency of the flexible ear flaps 88 to fold over onto the first attachment component(s) 46 thereby occluding the hooks from being secured during diaper application. Thus, the positioning patch 50 can comprise any element that provides a Z direction build up to the first attachment components 46. As shown in Figure 1, the positioning patches 50 each comprise a rectangular-shaped piece of material positioned subjacent the first attachment component 46. While the positioning patches 50 may be positioned directly subjacent the first attachment components 46, the positioning patches 50 are preferably positioned between the topsheet 24 and the backsheet 26 as shown in Figure 2. In order to provide a flexurally stiff circumference about the waist of the wearer, the lateral edges of the positioning patches can be abutted to or slightly overlapped with the side edges 75 of the elastic waistband member 76. The positioning patches 50 preferably comprise a 38 mm wide by 32 mm long patch of elastomeric foam. More preferably, during manufacture of the diaper, the positioning patches 50 are formed of the same material as the elastic side panel member 90 with the elastic side panel member 90 of one diaper and the positioning patch 50 of the adjacent diaper being formed from the same segment of material that is then cut after the diaper is completed. Thus, the positioning patch 50 extends from the end edge 64 of the diaper 20 inward toward the center of the diaper 20.

In a preferred embodiment, the diaper also comprises elasticized side panels 30 disposed in the second waist region 58. (As used herein, the term "disposed" is used to mean that an element(s) of the diaper is formed (joined and positioned) in a particular place or position as an unitary structure with other elements of the diaper or as a separate element joined to another element of the diaper.) The elasticized side panels 30 provide an elastically extensible feature that provides a more comfortable

and contouring fit by initially conformably fitting the diaper to the wearer and sustaining this fit throughout the time of wear well past when the diaper has been loaded with exudates since the elasticized side panels allow the sides of the diaper to expand and contract. Further, the elasticized side panels 30 develop and maintain wearing forces (tensions) that enhance the tensions developed and maintained by both the primary fastening system 38 and the waist closure system 40 to maintain the diaper 20 on the wearer and enhance the waist fit. The elasticized side panels 30 especially assist in initially pre-tensioning the elasticized waistband 34 since the diaperer typically stretches the elasticized side panels 30 when applying the diaper 20 on the wearer so that when the elasticized side panels 30 contract, tension is transmitted from the elasticized side panels 30 through the waist closure system 40 into the elasticized waistband 34. The elasticized side panels 30 further provide more effective application of the diaper 20 since even if the diaperer pulls one elasticized side panel 30 farther than the other during application (asymmetrically), the diaper 20 will "self-adjust" during wear. While the diaper 20 of the present invention preferably has the elasticized side panels 30 disposed in the second waist region 58; alternatively, the diaper 20 may be provided with elasticized side panels 30 disposed in the first waist region 56 or in both the first waist region 56 and the second waist region 58.

While the elasticized side panels 30 may be constructed in a number of configurations, an example of a diaper with elasticized side panels positioned in the ears (ear flaps) of the diaper is disclosed in U.S. Patent 4,857,067, entitled "Disposable Diaper Having Shirred Ears" issued to Wood, et al. on August 15, 1989, which patent is incorporated herein by reference. The elasticized side panels 30 may alternatively be formed in a number of other configurations. For example, U.S. Patent 4,381,781 issued to Sciaraffa, et al. on May 3, 1983, discloses a diaper having an elasticized waist in which an elastic member is positioned in an opening in both the topsheet and the backsheet of the diaper such that the stretch of the elastic member will not be constrained by

the non-elastic materials. While the Sciaffra et al. patent teaches the criticality of removing both the topsheet and the backsheet portions of the diaper in those areas coinciding with the elastic member, the present inventors have learned that satisfactory elastic performance can also be obtained when only one or when none of the coinciding portions of the topsheet and the backsheet are removed, especially when the portions of the diaper web containing the elastic member are subjected to an incremental mechanical stretching operation of the type described hereinafter. A further embodiment of a diaper showing elasticized side panels is shown in U.S. Patent 4,938,753 issued to Van Gompel, et al. on July 3, 1990. This patent discloses a pant-like garment provided with stretchable side panels formed by attaching discrete stretchable members to the side edges of the main body of the garment. Thus, the elasticized side panels 30 of the present invention may comprise a separate elastically extensible material or laminate joined to the diaper. As shown in Figure 1 and Figure 3, each elasticized side panel 30 preferably comprises an ear flap 88 and an elastic side panel member 90 operatively associated therewith.

As shown in Figure 1, each ear flap 88 comprises that portion of the side panel 72 that extends laterally outwardly from and along the side edge 82 of the absorbent core 28 to the longitudinal edge 62 of the diaper 20. The ear flap 88 generally extends longitudinally from the end edge 64 of the diaper 20 to the portion of the longitudinal edge 62 of the diaper 20 that forms the leg opening (this segment of the longitudinal edge 62 being designated as leg edge 106). In a preferred embodiment of the present invention, each ear flap 88 in the second waist region 58 is formed by the portions of the topsheet 24 and the backsheet 26 that extend beyond the side edge 82 of the absorbent core 28.

In a preferred embodiment of the present invention, the elastic side panel members 90 are operatively associated with the diaper 20 in the ear flaps 88, preferably between the topsheet 24 and the backsheet 26, so that the elastic side panel members 90

in the lateral direction (laterally elastically extensible). As used herein, the term "elastically extensible" means a segment or portion of the diaper that will elongate in at least one direction (preferably the lateral direction for the side panels and the waistbands) when tensional forces (typically lateral tensional forces for the side panels and the waistbands) are applied, and will return to about its previous size and configuration when the tensional forces are removed. Generally, elastomeric materials useful in the present invention will contractively return to at least about 75% of their original configuration within about 5 seconds or less upon stretch and immediate release thereof (i.e., a "snappy" elastic).

The elastic side panel members 90 can be operatively associated in the ear flaps 88 in a number of different ways. For example, the elastic side panel member 90 may be operatively associated in an elastically contractible condition so that the elastic side panel member 90 gathers or contracts the ear flap 88. (A more detailed description of a manner in which elastomeric materials may be secured in an elastically contractible condition can be found in U.S. Patent 3,860,003 issued to Buell on January 14, 1975, and in U.S. Patent 4,081,301 issued to Buell on March 28, 1978; both patents being incorporated herein by reference.) For example, the elastic side panel members 90 can be contractibly affixed in the ear flap 88 by laterally extending the elastic side panel member 90, joining the elastic side panel member 90 to either or both the topsheet 24 and the backsheet 26, and allowing the elastic side panel member 90 to assume its relaxed or contracted orientation.

Alternatively, the elastic side panel member 90 can be operatively associated in an uncontracted state and then treated to contract. For example, the elastic side panel member 90 can be formed from materials which contract undirectionally and become elastic following specific treatment such as heating. Examples of such materials are disclosed in U.S. Patent 3,819,401 issued to Massengale, et al. on June 25, 1974 and in U.S. Patent 3,912,565 issued to Koch, et al. on October 14, 1975. A more detailed description of a manner for using a heat-shrinkable elastic member

is described in U.S. Patent 4,515,595 issued to Kievit and Osterhage on May 7, 1985; this patent being incorporated herein by reference. Typically, the topsheet, the backsheet, the elastic side panel member, and any other components are secured together while in an uncontracted condition. The laminate is then heated (as with heated air) and the elastic side panel member is allowed to return to its relaxed or contracted orientation.

In an especially preferred embodiment, the elastic side panel member 90 is operatively associated in the ear flap 88 by joining the elastic side panel member 90 to the topsheet 24, the backsheet 26, or both while the elastic side panel member 90 is in a substantially untensioned condition. At least a portion of the resultant composite elastomeric laminate containing the elastic side panel member 90 is then subjected to mechanical stretching sufficient to permanently elongate the topsheet and the backsheet components (nonelastic components) of the laminate. The composite elastomeric laminate is then allowed to return to its substantially untensioned condition. The elasticized side panel is thus formed into a "zero strain" stretch laminate. (Alternatively, the elastic side panel member could be operatively associated in a tensioned condition and then subjected to mechanical stretching; although this is not as preferred as a "zero strain" stretch laminate.) As used herein, the term "zero strain" stretch laminate refers to a laminate comprised of at least two plies of material which are secured to one another along at least a portion of their coextensive surfaces while in a substantially untensioned ("zero strain") condition; one of the plies comprising a material which is stretchable and elastomeric (i.e., it will return substantially to its untensioned dimensions after an applied tensile force has been released) and a second ply which is elongatable (but not necessarily elastomeric) so that upon stretching the second ply will be, at least to a degree, permanently elongated so that upon release of the applied tensile forces, it will not fully return to its original undeformed configuration. The resulting "zero strain" stretch laminate is thereby rendered elastically extensible, at least up to the point of initial stretching, in the direction of initial stretching.

Examples of such "zero strain" stretch laminates are disclosed in U.S. Patent 2,075,189 issued to Galligan, et al. on March 30, 1937; U.S. Patent 3,025,199 issued to Harwood on March 13, 1962; U.S. Patent 4,107,364 issued to Sisson on August 15, 1978; U.S. Patent 4,209,563 issued to Sisson on June 24, 1980; and U.S. Patent 4,834,741 issued to Sabee on May 30, 1989. Each of these patents are incorporated herein by reference.

Particularly preferred methods and apparatus used for making "zero strain" stretch laminates out of a topsheet, a backsheet, and an elastomeric member positioned between the same, use meshing corrugated rolls to mechanically stretch the components. A discussion of suitable apparatus and methods for mechanically stretching portions of a diaper is contained in the hereinbefore referenced U.S. Patent 4,107,364 issued to Sisson on August 15; 1978 and U.S. Patent 4,834,741 issued to Sabee on May 30, 1989. Particularly preferred apparatus and methods are disclosed in co-pending, commonly assigned, U.S. Patent Application Serial No. 07/662,536 * entitled "Improved Method And Apparatus For Incrementally Stretching A Zero Strain Stretch Laminate Web To Impart Elasticity Thereto"; P&G Case 4339; filed by Gerald M. Weber et al. on February 28, 1991; U.S. Patent Application Serial No. 07/662,537 *entitled "Improved Method And Apparatus For Incrementally Stretching Zero Strain Stretch Laminate Web In A Non-Uniform Manner To Impart A Varying Degree of Elasticity Thereto"; P&G Case 4340; filed by Kenneth B. Buell et al. on February 28, 1991; and U.S. Patent Application Serial No. 07/662,543* entitled "Improved Method And Apparatus For Sequentially Stretching Zero Strain Stretch Laminate Web To Impart Elasticity Thereto Without Rupturing The Web"; P&G Case 4341; filed by Gerald M. Weber et al. on February 28, 1991; the specifications and drawings of which each are incorporated herein by reference.

Details of a particularly preferred incremental stretching system which can be employed in making "zero strain" stretch laminate elasticized side panels of the present invention are set forth in Figure 8. The fully assembled diaper web 810 including

(*see page 61 for equivalent applications)

the "zero strain" side panel web is directed through the incremental stretching system.

Referring to Figure 8, the timing of the diaper web 810 containing the substantially untensioned elastic side panel members (elastomeric patches 804) is such that the substantially untensioned elastomeric patches 804 substantially coincide with the corrugated or grooved segments 824 contained on the uppermost corrugated rolls 825 as the diaper web 810 passes between the segments 824 of the uppermost corrugated rolls 825 and the continuously corrugated or grooved lowermost corrugated rolls 821. In a preferred embodiment of the method and apparatus, the grooved segments 824 are of greater overall length than the elastomeric patches 804, as measured in the machine direction, so as to impart a degree of extensibility to those portions of the topsheet 24 and the backsheet 26 which are adjacent the elastomeric patches 804 in the diaper 20 (i.e., an extension panel 110 is formed). In addition, the grooved segments 824 preferably are not of sufficient length to extend into the first waist region of the adjacent diaper, since it is preferable not to impart a degree of extensibility to the portion of the elastomeric patch 804 that will form the positioning patch 50 of the adjacent diaper.

While the exact configuration, spacing and depth of the complementary grooves on the uppermost and lowermost corrugated rolls will vary, depending upon such factors as the amount of elasticity desired in the "zero strain" stretch laminate portion, a peak-to-peak groove pitch of approximately 0.150 inches, an included angle of approximately 12 degrees as measured at the peak, and a peak-to-valley groove depth of approximately 0.300 inches have been employed in a particularly preferred embodiment of the present invention. The exterior peak of each corrugation on the aforementioned corrugated rolls typically exhibits a radius of approximately 0.010 inches, while the internal groove formed between adjacent corrugations typically exhibits a radius of approximately 0.040 inches. When the corrugated rolls are adjusted so that their opposing peaks overlap one another to a depth between about 0.150 and about 0.175 inches, good elastic characteristics have been produced in a laminate web of the

present invention comprised of 80 mil thick elastomeric polyurethane foam patches substantially continuously bonded on their opposed surfaces to a one mil thick polymeric backsheet and a nonwoven topsheet having a basis weight in the range of about 18 to 20 grams per square yard and comprised of polypropylene fibers.

The degree of overlap of the opposing peaks on the aforementioned corrugated rolls may of course be adjusted, as desired, to produce more or less extensibility in the resultant "zero strain" stretch laminate web. For the aforementioned roll geometry and laminate web construction, peak-to-peak overlap depths ranging from as little as about 0.050 inches to as much as about 0.225 inches are feasible.

As can be seen from Figure 8A, the diaper web 810 is caused by the idler rolls 872, 874 to wrap the lowermost corrugated rolls 821 sufficiently to cover the active vacuum ports 822 (shown in Figure 8) located immediately adjacent each continuous set of grooves 823 on the lowermost rolls 821. The vacuum ports 822, which are positioned so as to substantially coincide with the grooved segments 824 on the uppermost corrugated rolls 825, are internally connected through the rolls 821 to a pair of vacuum manifolds 826 which exert suction against the diaper web 810 as the diaper web is acted upon by the grooved segments 824 of the uppermost corrugated rolls 825.

To minimize the build up of either the adhesive used to secure the untensioned elastomeric patches 804 to the topsheet web 806 and the backsheet web 805 or the adhesive used to secure the coinciding portions of the topsheet web and the backsheet web to one another, the grooved segments 824 on the uppermost rolls 825 and the continuous grooves 823 on the lowermost rolls 821 may be either comprised of a low friction material, such as TEFLON, or coated with a self-lubricating low friction material such as Permalon No. 503 spray coating, as available from Micro Surface Corporation of Morris, Illinois.

The vacuum ports 822 on the lowermost rolls 821 are preferably covered by a porous material, such as 0.090 inch mesh honeycomb 844, to provide support to the portions of the diaper web 810 acted upon by the vacuum and to provide a good gripping

surface against the web so as to substantially prevent lateral slippage or movement of the web across the honeycomb surface whenever the web is acted upon by the vacuum.

Under optimum circumstances, the maximum degree of incremental stretching which can be imparted to the "zero strain" portions of the side panel containing the elastomeric patches 804 is determined by the depth of engagement between the grooves on segments 824 of the uppermost corrugated rolls 825 and the continuous grooves 823 on the lowermost corrugated rolls 821. However, it has been discovered that unless the stretch laminate web is substantially prevented from slipping or contracting in a direction substantially parallel to the direction of web stretching as it passes between the meshing corrugated rolls, the optimum degree of incremental stretching is not realized. Therefore, in its most preferred form, the incremental web stretching operation is carried out while the outermost portions of all three layers comprising the "zero strain" stretch laminate are subjected to restraint, as generally shown in the cross-section of Figure 8B, to substantially prevent the "zero strain" stretch laminate portions of the diaper web from slipping or contracting in a direction parallel to the desired direction of stretching as it passes between the sets of sequentially positioned meshing corrugated rolls.

However, the present invention may also, if desired, be practiced to advantage by restraining only the elongatable or drawable layer or layers of the composite, i.e., it is not an absolute requirement that the outermost portions of the elastomeric patches also be restrained during the incremental stretching operation. In the latter instance, the elongatable or drawable layer or layers are still permanently elongated during the incremental stretching process, but the z-direction bulking in the resultant "zero strain" stretch laminate web may be somewhat less pronounced when the stretching tension is removed. This is due to the fact that the elastomeric patch undergoes a lesser degree of initial stretching during such a process. Accordingly, it can only undergo this same amount of retraction when it returns to its undistorted configuration.

A "zero strain" stretch laminate embodiment of the aforementioned type may also exhibit some degree of disproportionate localized straining in the elongatable web or webs, particularly in the areas immediately adjacent the opposed edges of the elastomeric patches. In the case of an opaque polymeric backsheet web, these disproportionately strained portions can become sufficiently thinned that they may even appear transparent despite the fact that no rupture has taken place. In such instances the functionality, (e.g., the imperviousness) of the "zero strain" stretch laminate portions of the diaper web is not impaired. Embodiments of the latter type are normally employed in situations where the aesthetic appearance of the "zero strain" stretch laminate portions of the resultant diaper is either hidden from view by the design or configuration of the diaper or, if visible, is of no concern to the user of the diaper.

In still another embodiment of the present invention even rupture of one or more of the elongatable nonelastic webs may not render the resultant "zero strain" stretch laminate web unacceptable for its intended purpose (e.g., rupture of the backsheet web does not necessarily destroy the laminate web's functionality for its intended purpose as long as one of the other plies in the laminate web provides the desired function in the finished article). For example, some degree of rupturing in the elongatable backsheet web will not destroy the imperviousness of the resultant diaper web if the elastomeric patches comprise a liquid-impervious material). This is particularly true with respect to those "zero strain" stretch laminate web embodiments employing substantially continuous bonding between the plies in question, since relatively close adherence of the plies to one another after incremental stretching renders such ply damage difficult to detect by the end user or the diaperer.

Because the diaper web 810 shown in Figures 8-8B is substantially impervious to the passage of air by virtue of the presence of the uppermost backsheet web 805, the vacuum ports 822 covered by the porous honeycomb material 844 can, if desired, be employed immediately adjacent each set of machine direction oriented grooves 823 in the lowermost corrugated rolls 821. If

the elastomeric patches 804 are sufficiently pervious to the passage of air, the suction forces generated by the vacuum will pass through the topsheet web 806 and the elastomeric patches 804 so as to tightly grip the overlying portions of the backsheet 805. In this instance, all three layers comprising the "zero strain" stretch laminate portions of the diaper web will be restrained during the incremental stretching operation.

If the elastomeric patches were not substantially pervious to the passage of air, it would be necessary to either (a) position the vacuum ports 822 and the overlying honeycomb material 844 just outside the opposed edges of the elastomeric patches 804 so that suction forces could be exerted on the backsheet web 805 through the topsheet web 806; or (b) restrain all three layers comprising the "zero strain" stretch laminate portions of the diaper web by means of suitable clamping apparatus capable of acting upon the opposed surfaces of the diaper web.

The suction forces applied to the diaper web 810 shown in Figures 8-8B by the vacuum ports 822 acting through the porous honeycomb material 844 substantially prevent those portions of the diaper web 810 containing the substantially untensioned elastomeric patches 804 from slipping or contracting in a laterally inward direction as they pass between the meshing portions of the continuous grooves 823 on the lowermost corrugated rolls 821 and the grooved segments 824 on the uppermost corrugated rolls 825.

Because the "zero strain" stretch laminate portions of the diaper web 810 containing the elastomeric patches 804 are laterally restrained throughout the sequential web stretching operation, all portions of the "zero strain" stretch laminate web located intermediate the points of restraint are subject to substantially uniform incremental stretching as the web passes between the continuous grooves 823 on the lowermost corrugated rolls 821 and the meshing portions of the grooved segments 824 on the uppermost corrugated rolls 825.

This not only maximizes the effectiveness of the incremental web stretching operation by forcing the elongatable topsheet and backsheet webs secured to the elastomeric patches to undergo the

fullest possible degree of elongation during the stretching operation, but also substantially prevents disproportionately high straining of the topsheet and/or backsheet webs to which they are secured in the areas immediately adjacent the opposed peripheral edge portions of the elastomeric patches.

Figure 9 discloses an alternative incremental web stretching system which can be employed. In the incremental web stretching system shown in Figure 9, a pair of resiliently compressible disks 940 are mounted adjacent each side of the grooved segments 924 of the uppermost corrugated rolls 925. The compressible disks 940 are of a large enough diameter that they tightly grip the diaper web 910 and hold it securely against the coinciding non-grooved portions of the lowermost corrugated rolls 921 as generally shown in the cross-section of Figure 9A. Like the vacuum ports and the porous honeycomb material in the embodiment of Figure 8, the clamping effect created by the compressible disks 940 and the coinciding non-grooved portions of the lowermost rolls 921 substantially prevents the portion of the diaper web 910 containing the elastomeric patches 904 from contracting in a direction parallel to the direction of stretching as the web passes between the meshing corrugated rolls. The Figure 9 embodiment can be used with equal facility on laminate structures comprised of webs which are either pervious or impervious to the passage of air.

As will be appreciated by those skilled in the art, the foregoing restraint methods may be employed either individually or in combination with one another to produce the benefits herein described in the resultant "zero strain" stretch laminate portions of the resultant diaper web.

From the description contained herein, it is clear that the improved method and apparatus may be employed to advantage to produce a wide range of diapers either comprised entirely of or including one or more discrete, isolated "zero strain" stretch laminate web portions.

It is also recognized that while a pair of meshing corrugated rolls having their corrugations aligned substantially parallel to one another are disclosed in the accompanying drawings, the

present invention may be practiced with equal facility employing pairs of corrugated rolls wherein the corrugations are not all oriented parallel to one another. Furthermore, the corrugations on such pairs of corrugated rolls need not necessarily be aligned parallel to either the machine or the cross-machine direction. For example, if a curvilinear waistband or legband portion is desired in a single use diaper constructed using the "zero strain" stretch laminate technology herein disclosed, the meshing teeth on the pairs of corrugated rolls employed to incrementally stretch the "zero strain" laminate web portions of the diaper web may be arrayed in the desired curvilinear configuration to produce elasticity along the desired curvilinear contour rather than in a straight line.

It is further recognized that while the preferred processes herein disclosed employ meshing cylindrical corrugated rolls, the web restraint principles may also be carried out utilizing an intermittent stamping operation employing meshing platens to incrementally stretch the "zero strain" stretch laminate portions of the web or article in question. In the latter instance, the only requirement is that the portions of the "zero strain" stretch laminate web to be incrementally stretched be adequately restrained by suitable vacuum or clamping means before the meshing platens are able to exert enough force on the web to cause slippage or contraction in a direction parallel to the direction of stretching.

The elastic side panel members 90 can be joined to either the topsheet 24, the backsheet 26, or both using either an intermittent bonding configuration or a substantially continuous bonding configuration. As used herein, an "intermittently" bonded laminate web means a laminate web wherein the plies are initially bonded to one another at discrete spaced apart points or a laminate web wherein the plies are substantially unbonded to one another in discrete spaced apart areas. Conversely, a "substantially continuously" bonded laminate web means a laminate web wherein the plies are initially bonded substantially continuously to one another throughout the areas of interface. The intermittent bonding configuration is normally desirable for

"zero strain" laminate webs in those situations where the substantially inelastic webs in the laminate are relatively elongatable or drawable without rupture and where a high degree of z-direction bulking is desired in the finished laminate. A continuous bonding configuration has generally been found desirable for "zero strain" laminate webs where the degree of z-direction bulking of the finished laminate is not of prime importance and one or more of the relatively inelastic webs in the laminate is difficult to elongate or draw without causing rupture. In the latter situation, a substantially continuous bonding configuration maintains all of the layers of the laminate in relatively close adherence to one another after the incremental stretching operation. Accordingly, even if one or more of the relatively inelastic webs is damaged to the point of rupture during the incremental stretching operation, the relatively close adherence of the damaged portions of the relatively inelastic web or webs to the elastomeric ply makes it difficult for the end user to perceive that any damage has occurred. Provided that the rupture of the relatively inelastic web or webs does not defeat the web's intended functionality, (e.g., imperviousness), the damage which does occur to the relatively inelastic web or webs during the incremental stretching operation is generally not perceived as a negative in the end product.

Thus, an unexpected benefit which results from the use of a continuous bonding configuration in particularly preferred "zero strain" stretch laminate webs is that it permits the manufacturer of the diaper to select from a much wider range of relatively inelastic webs which may be successfully employed in laminates of the present invention. In essence, it permits the use of relatively inelastic webs which would not normally be considered drawable to any appreciable extent in "zero strain" stretch laminate webs of the present invention. Accordingly, unless expressly stated otherwise, the term "drawable" as used herein, is not intended to exclude relatively inelastic webs which undergo a degree of thinning or damage during the incremental stretching operation.

In a preferred embodiment of the present invention, the elastic side panel member 90 is substantially continuously bonded to both the topsheet 24 and the backsheet 26 using an adhesive. A glue applicator may be used to apply a substantially uniform and continuous layer of adhesive to the backsheet 26 and/or the topsheet 24 in those predetermined areas where the substantially untensioned elastic side panel member 90 will be placed. In a particularly preferred embodiment, the adhesive selected is stretchable and the glue applicator comprises a melt blown applicating system.

One such melt blown adhesive applicating system which has been found to be particularly well suited for producing a substantially continuously bonded "zero strain" stretch laminate web is a melt blown spray applicator Model No. GM-50-2-1-GH, as available from J&M Laboratories of Gainesville, Georgia. The latter system employs a nozzle having 20 orifices per lineal inch, as measured in the cross-machine direction, each orifice measuring approximately 0.020 inches in diameter. A Findley H-2176 Hot Melt Adhesive, as available from Findley Adhesives of Elm Grove, Wisconsin is preferably heated to a temperature of approximately 340°F and applied to the backsheet and/or the topsheet at a rate of approximately 7.5-10 milligrams per square inch. Heated compressed air at a temperature of approximately 425°F and a pressure of approximately 50 psig is issued through the secondary orifices in the adhesive nozzle to assist in uniformly distributing the adhesive fibrils during the laydown operation.

The intimate contact of the hot adhesive with the backsheet 26 for the time which passes prior to the incremental stretching of the resultant "zero strain" stretch laminate portion of the diaper provides softening of the backsheet 26. For some webs, such as conventional polyethylene backsheet material, this softening has been found beneficial in minimizing damage to the backsheet during the incremental web stretching process. This may be particularly important in situations where the web in question imparts some function, (e.g., impervious), to the diaper.

Alternatively, the elastic side panel member 90 and any other components comprising the "zero strain" portions of the diaper 20

may be intermittently or continuously bonded to one another using unheated adhesive, heat bonding, pressure bonding, ultrasonic bonding, dynamic mechanical bonding, or any other method as is known in the art.

The elastic side panel members 90 may take on a number of different sizes, shapes, configurations and materials. For example, the elasticized side panels 30 may be formed from one or a plurality of elastic side panel members 90 operatively associated in each ear flap 88; the elastic side panel members may have varying widths and lengths; or the elastic side panel members may comprise relatively narrow strands of elastomeric material or a larger area elastomeric patch. One elastomeric material which has been found to be especially suitable for use as the elastic side panel member 90 (especially for "zero strain" stretch laminates) is an elastomeric foam having an elongation to break of at least about 400% and an extension force of at least about 200 grams per inch of sample width at 50% extension of its unstrained length. Exemplary elastomeric foams which have been found suitable for use as an elastic side panel member include: (a) crosslinked natural rubber foams preferably having a caliper of approximately 50 mils and a density of 13.3 pounds per cubic foot (0.214 g/cm^3), such as is available from Fulflex Inc. of Middletown, Rhode Island; or as available from Ludlow Composites Corporation of Fremont, Ohio; or (b) polyurethane foams having a caliper of approximately 80 mils and a density of approximately 2.06 pounds per cubic foot (0.033 g/cm^3) such as is available from Bridgestone of Yokohama, Japan and marketed under the tradename Bridgestone SG polyurethane foam; or as available from General Foam of Paramus, New Jersey and marketed under the designation of Polyurethane Foam No. 40310. Other suitable elastomeric materials for use as the elastic side panel members 90 include "live" synthetic or natural rubber, other synthetic or natural rubber foams, elastomeric films (including heat shrinkable elastomeric films), elastomeric scrim, elastomeric woven or nonwoven webs, elastomeric composites such as elastomeric nonwoven laminates, or the like.

As shown in Figure 1, the elastic side panel member 90 comprises a patch of elastomeric material (elastomeric patch) that preferably extends through a majority of the length of the ear flap 88 in the second waist region 58. When the diaper is manufactured, the elastomeric patch is preferably positioned so that it forms not only the elastic side panel member 90 of one diaper but also the positioning patch 50 in the first waist region 56 of the adjacent diaper. Thus, registry problems in securing the elastic side panel members to the diaper at high speed, such as disclosed in the previously referenced Wood, et al. patent, are eliminated. Thus, the elastic side panel member 90 preferably extends from the end edge 64 of the diaper 20 inward toward the leg edge 106 of the ear flap 88. The length and width of the elastic side panel members 90 are dictated by the diaper's functional design.

While the elastic side panel member 90 may longitudinally extend through the entire length of the ear flap 88, it is preferred that the elastic side panel member 90 extend through only a portion of the length of the ear flap 88 so as to form an extension panel 110. As shown in Figure 1, the extension panel 110, the portion of the elasticized side panel longitudinally extending from the base edge 108 of the elastic side panel member 90 to the leg edge 106 of the ear flap 88, has also been mechanically stretched at least to a degree to be extensible (i.e., the materials that make up the extension panel 110 have been prestrained or permanently elongated). This "prestrained" extension panel allows this portion of the elasticized side panel to effectively elongate (yield) when the "zero strain" stretch laminate portion of the elasticized side panel is extended, without generating excessive tension forces near the leg regions of the wearer that could cause skin irritation or red marking in the legs. (i.e., Without the "prestrained" extension panel, tensional forces would be concentrated along a line through the extension panel 110 when the elasticized side panel is extended that could indent, rub, or chafe the skin of the wearer.) While there are a number of ways to prestrain the extension panel 110 of the elasticized side panels 30, the extension panel 110 is

preferably prestrained in the same manner as the mechanical stretching performed on the "zero strain" stretch laminate portion. While the extension panel 110 of the elasticized side panels 30 may be formed from a number of different materials, in the preferred embodiment shown in Figure 1, the extension panel 110 is formed from the portions of the topsheet 24 and the backsheet 26 forming the ear flap 88.

It has been found that the extension characteristics including the extension forces, extension modulus, and available stretch (extension); and the contractive forces; elastic creep; elastic hysteresis; and rate of contraction of the elasticized side panels 30 are important considerations in the performance of both the elasticized side panels 30 and the diaper 20. The extension characteristics give the diaperer and wearer the overall perceived "stretchiness" during use. They also affect the ability of the diaperer to achieve a suitable degree of application stretch (i.e., for a "normally" perceived tensioning of the diaper during application, the total amount of resultant stretch is that desired to achieve/maintain good conformity of fit). An elasticized side panel with a relatively high extension modulus can cause red marking on the wearer's skin while a relatively low extension modulus can cause sagging/slipping on the wearer. Elasticized side panels having too little available stretch may not achieve a suitable level of body conformity and may contribute in making the diaper uncomfortable to wear and hard to apply. A diaper having elasticized side panels with very low contractive forces, or poor elastic creep or elastic hysteresis may not stay in place on the wearer and may tend to sag/slip on the wearer resulting in poor fit and containment.

For the elasticized side panels 30 of the present invention, it has been found that the extension characteristics of extension force and extension modulus are preferably within defined ranges. The extension force preferably is greater than or equal to about 250 gramsf. It is preferred that these extension forces be generated at extensions between about 0.25 inches (6.25 mm) and about 1.25 inches (31.25 mm). For the most preferred embodiments for use on medium or large sized diapers, the elasticized side

panels preferably have an extensional force between about 250 gramsf and about 500 gramsf at an extension of between about 0.25 inches (6.25 mm) and about 0.75 inches (18.75 mm).

Available stretch measures the maximum amount of material available in the elasticized side panels to reversibly stretch to conform to the wearer's body during wear. Thus, the amount of available stretch relates to the maximum amount of extension that the diaperer has available to fit the diaper to the wearer; in addition, the maximum amount of recoverable extension available for the diaper to comply with wearer's body. The available stretch is calculated from the equation: ((stretched length - original length) - original length) x 100. The minimum amount of available stretch required for a diaper application using elasticized side panels is preferably an available stretch of at least about 35% for medium sized diapers (infants typically weighing from about 12 pounds to about 25 pounds) and at least about 50% for large sized (infants typically weighing from about 20 pounds to about 35 pounds) diapers.

The amount of sustainable contractive force (tension) exerted by the elasticized side panel on the wearer is an important property of the elasticized side panel. An elasticized side panel with insufficient contractive forces may result in the diaper slipping down after being worn and loaded. In contrast, excessive contractive forces may reduce the comfort for the wearer and produce pressure markings on the wearer's skin. Contractive force is measured as the force per unit width produced while relaxing an elastomeric composite at a particular extension. In preferred embodiments of the present invention, the contractive force of the elasticized side panels is preferably at least about 90 grams/inch at 50% extension (a 50% extension would require the sample to be stretched to 1.5 times its original length).

Typical elastomeric materials show a hysteresis loop of force in their stress-strain property. That is, for a given extension, the force (extension force) required to uniaxially extend the elastomeric material is greater than the force (contractive force) the elastomeric material exerts when it is allowed to contract from its pre-extended condition. The former curve can be referred

to as the "load curve" and the latter curve can be referred to as the "unload curve". The "load" extension force (extension force) is felt by the diaperer when the elasticized side panel is stretched to apply the diaper to the wearer. The wearer more nearly "feels" the "unload" contractive forces (contractive forces) once the diaper is on. Therefore, the hysteresis loss should not be so great that the contractive force is low enough to allow sagging/slipping of the diaper on the wearer.

All elastomeric materials undergoing sustained stress/strain have diminishing forces with time (i.e., elastic creep). Therefore, it is desired to make sure this reduction in wearing forces over time doesn't fall below a minimum for wearing stability. The elastic creep should therefore be kept at a minimum. In preferred embodiments of the present invention, the final length of the elastomeric material is not greater than about 1.2 times the original length under tension for 30 minutes.

The extension forces and available stretch of the elasticized waistband 34 can be important considerations in the performance of both the elasticized waistband 34 and the elasticized side panels 30. While the extension forces of the elasticized waistband 34 may be greater than the extension forces of the elasticized side panels 30, in a preferred embodiment of the present invention, the extension forces of the elasticized waistband 34 at its designed extensions is less than or equal to the extension forces of each elasticized side panel 30 at its designed extensions. An elasticized waistband 34 having lower extension forces than that of the elasticized side panels 30 provides for easy stomach movement without displacing the diaper on the child. The higher extension force elasticized side panels allow for small dimensional changes over the hip and under the stomach to keep the product comfortably in tension on the wearer. This design provides better fit, less leakage and improved comfort for the wearer through the reduction of sagging, gapping, rollover and roll-in at the front of the diaper and overall sliding/slipping of the diaper or diaper absorbent core on the wearer during use. As discussed herein, Figure 5 discloses an alternative embodiment of the present invention wherein the shaped "expansive tummy panel"

preferably has lower extension forces [and/or higher available stretch] than the elasticized side panels to provide the improved performance discussed herein.

The elasticized side panels 30 may also be provided with differential extensibility along the longitudinal axis when stretched in the lateral direction. As used herein, the term "differential extensibility" is used to mean a material having a nonuniform degree of elastic extensional properties, as measured in the direction of stretching at various points along an axis oriented substantially perpendicular to the direction of stretching. This may, for example, include varying the elastic modulus or available stretch or both of the elastomeric material(s). The differential extensibility is preferably designed into the elasticized side panels 30 so that the lateral extensibility varies longitudinally through at least a portion of the elasticized side panel as measured from the end edge 64 of the diaper 20 to the leg edge 106 of the ear flap 88. Without wishing to be bound by any theory, it is believed that differential extensibility along the longitudinal axis when stretched in the lateral direction allows the elasticized side panel to differentially stretch and conform to the wearer's waist during use while providing a secure anchor about the hip of the wearer so as to promote sustained fit and reduce leakage at the waist and legs. Such a configuration may allow more "expansion" in the hip area to accommodate changes in the wearer's body size as the wearer moves and changes positions (standing, sitting, lying). In an alternative embodiment, a degree of reduced lateral extensibility in the portion of the elasticized side panel adjacent to the end edge 64 of the diaper 20 requires more of the total extension to be assumed by the elasticized waistband 34 thereby resulting in more localized stretching of the elasticized waistband 34 and a more compliant abdominal fit.

The differential extensibility can be achieved in a number of different ways. The elasticized side panels 30 can have multiple combined elastomeric materials, multiple configurations for the elastomeric materials, or the extension properties of the elastomeric or other material or materials making up the

elasticized side panel may be nonuniform. For example, differential extensibility can be achieved in selected adjacent portions of the elasticized side panel by using elastomeric materials having varying extension or contractive forces, modulus, or other inherent properties such that more or less (varying) lateral extensibility is achieved in one portion of the elasticized side panel than the adjacent portion. The elastomeric materials may also have varying lengths, sizes, and shapes that provide differential extensibility. Other ways of varying the properties of materials that form the elasticized side panels as are known in the art may also be used.

A particularly preferred method and apparatus for imparting a varying degree of extensibility to a "zero strain" stretch laminate is to pass the "zero strain" stretch laminate through at least one set of meshing corrugated rolls, at least one of the corrugated rolls having corrugations of nonuniform profile along its point or points of contact with the "zero strain" stretch laminate web. As a result, the portions of the laminate web passing between the set of rolls are nonuniformly stretched. This, in turn, produces a "zero strain" stretch laminate which is nonuniformly elasticized in a direction substantially perpendicular to the nonuniformly profiled corrugations.

The diaper 20 is preferably applied to a wearer by positioning one of the waist regions, preferably the second waist region 58, under the wearer's back and drawing the remainder of the diaper between the wearer's legs so that the other waist region, preferably the first waist region 56, is positioned across the front of the wearer. The tab portions 94 of the tape tabs 92 are then released from the release portion 95. The diaperer then wraps the elasticized side panel 30 around the wearer, while still grasping the tab portion 94. The elasticized side panel 30 will typically be extended and tensioned during this operation so as to conform to the size and shape of the wearer. The first fastening component 112, the adhesive attachment layer 96, is secured to the second fastening component 114 of the landing member 44 to effect a side closure. In the preferred embodiment of the present invention, when the side closure is formed, the waist closure is

also "automatically" formed, i.e., the waist closure is passively activated. The waist closure is formed by the engagement of the first attachment components 46 with the second attachment component 48. With the formation of the waist closure, the elasticized waistband 34 is pretensioned so as to provide the fit and containment benefits described herein.

Figure 4 shows a perspective view of the diaper 20 of the present invention as it would look as applied to a wearer. A side closure is formed by the engagement of the first fastening component 112 on the tape tab 92 with the second fastening component 114 on the landing member 44. The waist closure is formed by the engagement of the first attachment components 46 with the second attachment component 48. Figure 4 especially shows an example of the deformation of the elasticized side panels 30 caused by the tensions created by the formation of the side closure and the tensions created in both the elasticized waistband 34 and the elasticized side panel 30 by the waist closure. The elasticized side panel 30 has been stretched when the diaper was applied to the wearer. The elasticized side panel 30 subsequently contracted to some extent so as to enhance the pretensioning of the elasticized waistband 34. The elasticized side panel 30 also provides a more comfortable and contouring fit for the diaper 20. The elasticized side panel 30 further provides improved application for the wearer as the consumer can pull one side tighter than the other because the product will "self-adjust" as the baby wears it.

Figure 5 shows an alternative embodiment of the elasticized waistband of the present invention. As shown in Figure 5, the elasticized waistband 534 has a deep "pentagon" shape to form an "expansive tummy panel". This shape provides an elasticized waistband 534 that moves and expands with the wearer's stomach as well as differential lateral extensibility such that portions of the elasticized waistband adjacent the end edge 64 are more extensible than adjacent portions farther from the end edge 64. In this embodiment, the elasticized waistband 534 comprises a stretch laminate formed by mechanically stretching a portion of the backsheet 26, a portion of the topsheet, and an elastic

waistband member that has been operatively associated in the elasticized waistband, preferably in a tensioned condition although it could comprise a "zero strain" stretch laminate, in a shape corresponding to the desired shape of the elasticized waistband 534. This stretch laminate (preferably a mechanically stretched, pretensioned, elastomeric stretch laminate) elasticized waistband allows for expansion of the elasticized waistband well beyond the dimensions of the circumference of the diaper formed by the primary closure system and beyond the initial dimension of the end edge 64 (beyond the planar state of the diaper itself). The elasticized waistband 534 has a portion of the bachsheet 26 removed adjacent the end edge 64 of the diaper 520 to allow the elasticized waistband 534 to more fully stretch in this region (a "windowed" elasticized waistband). In an alternative embodiment, the backsheet need not be removed. As shown in Figure 5, the landing member 544 follows the contours of the elasticized waistband 534 to stiffen adjacent portions of the diaper and is placed longitudinally farther from the end edge of the diaper so as not to restrict the extension of the elasticized waistband and allow lower taping of the primary fastening system. (The tape tabs are also correspondingly moved farther from the end edge in the second waist region.) The waist edge 83 of the absorbent core 28 is generally parallel to the end edge 64 of the diaper (a straight line) and is moved longitudinally farther away from the end edge 64 to provide for the deeper "expansive tummy panel". The first attachment components 46 are longitudinally longer because of the preferred shape of the elasticized waistband, because of the desire to pretension a greater area of the deeper elasticized waistband, and because of the preferred lower securement of the primary fastening system. The positioning patch is laterally wider so as to abut with or extend beyond the side edge 75 of the elastic waistband member 76 to add additional stiffness in the first side panels 70 that decrease the folding of the first side panel at the crease between the elastic waistband member 76 and the positioning patch 50. A more complete description of an elasticized waistband of this type is described in the co-pending, commonly assigned, U.S. Patent Application, P&G

Case 4413,* Buell et al., "Absorbent Article with Dynamic Elastic Waist Feature Having A Predisposed Resilient Flexural Hinge", filed concurrently herewith and the specification and drawings of which are incorporated herein by reference.

Figure 6 shows an alternative embodiment of the elasticized waistband 634 shown in Figure 5. As shown in Figure 6, the shape of the waist edge 683 of the absorbent core 28 has an arcuate shape. The arcuate shape absorbent core has ears 600 which extend upwardly beyond the elasticized waistband 534 to bound a portion of the elasticized waistband and to further stiffen the areas adjacent the elasticized waistband 534 and provide additional containment.

Figure 7 shows a further alternative embodiment of the present invention wherein the waist closure system 740 comprises a first attachment component 746 comprising a unitary portion of the backsheet 26 and a pair of second attachment components 748 comprising a separate patch of a hook fastening material joined to the topsheet 24. In the embodiment shown in Figure 7, the backsheet 26 is preferably formed from a laminate of a polyethylene film 701 and a nonwoven layer 702. The polyethylene film 701 is preferably positioned adjacent the garment surface 100 of the absorbent core 28 (i.e., between the absorbent core 28 and the nonwoven layer 702) so that the nonwoven layer 702 forms a portion of the outer surface 52 of the diaper 720. This nonwoven layer 702 of the backsheet 26 acts as the first attachment component 746 for the hook fastening material of the second attachment components 748. The second attachment components 748 are similar to the first attachment components described with respect to Figure 1. The second attachment components 748 are positioned so as to be longitudinally aligned with the elasticized waistband 34 of the first waist region 56. Further, the second attachment components 748 are preferably positioned between the longitudinal edge 62 of the diaper 720 and the elastic side panel members 90 in the ear flaps 88 so that the stretch capability of the elasticized side panels 30 is not limited.

Without wishing to be bound by theory, the diaper embodiment of Figure 7 provides full utilization of the elasticized side

(*see page 61 for equivalent application)

panels 30. The positioning of the second attachment components 748 ensures that the elasticized side panels 30 will be allowed to expand to fully pretension the elasticized waistband.

Another advantage of this embodiment is believed to be in diaper application. This embodiment allows the user to tape the tab portion 94 anywhere on the landing member 44 with the hook fastening material of the second attachment component 748 engaging the first attachment component 746 without the need for the defined lateral spacing of the anchor zones.

While particular embodiments of the present invention have been illustrated and described, it would be obvious to those skilled in the art that various other changes and modifications can be made without departing from the spirit and scope of the invention. It is therefore intended to cover in the appended claims all such changes and modifications that are within the scope of this invention.

CLAIMS:

1. An absorbent article, preferably a unitary disposable absorbent article, having longitudinal edges, end edges, a first waist region, a second waist region opposed to said first waist region, an outer surface, and an inner surface, the absorbent article comprising:

a containment assembly comprising an outer covering layer and an absorbent core having side edges and waist edges, preferably said containment assembly comprising a liquid pervious topsheet, a liquid impervious backsheet joined to said topsheet, and an absorbent core positioned between said topsheet and said backsheet;

an elasticized waistband disposed longitudinally outwardly from and along a portion of said waist edge of said absorbent core in said first waist region, said elasticized waistband being elastically extensible in at least the lateral direction; and

characterized in that a dual tension fastening system is disposed on the absorbent article, said dual tension fastening system comprising:

(i) a primary fastening system for providing a side closure for the absorbent article by maintaining said first waist region and said second waist region in an overlapping configuration such that lateral tension is maintained around the circumference of the absorbent article to maintain the absorbent article on the wearer, said primary fastening system comprising:

(a) a securement member disposed adjacent each of said longitudinal edges in said second waist region; and

(b) at least one landing member disposed in said first waist region, said landing member being engageable with said securement members; and

(ii) a waist closure system for providing a variable positioning, passively activated waist closure for the absorbent article that dynamically maintains/creates lateral tension through at least a portion of said elasticized waistband, said waist closure system comprising:

(a) at least one first attachment component disposed in said first waist region, said first attachment component being positioned so as to be longitudinally aligned with said elasticized waistband, and

(b) at least one second attachment component disposed in said second waist region, said second attachment component being engageable with said first attachment component so that when the primary closure is formed, said second waist region overlaps said first waist region such that said second attachment component engages said first attachment component at at least two anchor zones longitudinally aligned with said elasticized waistband so as to dynamically maintain/create lateral tension through at least a portion of said elasticized waistband.

2. The absorbent article of Claim 1 wherein said waist closure system comprises:

(a) a pair of first attachment components preferably joined to said backsheet in said first waist region, said first attachment components being positioned so as to be longitudinally aligned with said elasticized waistband, preferably longitudinally offset from said tape tabs, and more preferably laterally spaced from

each other by at least about 25 mm, said first attachment components preferably each comprising a first mechanical closure element comprising a hook fastening material or a loop fastening material; and

(b) at least one second attachment component disposed in said second waist region, said second attachment component preferably comprising a second mechanical closure element comprising a loop fastening material or a hook fastening material mechanically engageable with said first mechanical closure element so that when the primary closure is formed, said second waist region overlaps said first waist region such that said second attachment component engages said first waist attachment component to dynamically maintain/create lateral tension through at least a portion of said elasticized waistband.

3. The absorbent article of Claim 2 wherein said topsheet comprises said loop fastening material of said second attachment component, and wherein said hook fastening material of said first attachment component comprises an array of prongs having engaging elements oriented inward toward the longitudinal centerline of the absorbent article.

4. The absorbent article according to any of the preceding claims wherein each securement member comprises a tape tab having a fixed portion joined to said outer covering layer, a tab portion extending outwardly from said longitudinal edge and joined to said fixed portion, and a first fastening component disposed on said tab portion.

5. The absorbent article of Claim 4 either wherein said first fastening component of said tape tab comprises an adhesive attachment layer for adhesively securing said tape tab to said landing member, said landing member comprising a second fastening component preferably comprising a portion of said

backsheet or a separate reinforcing strip joined to said backsheet; or wherein said first fastening component comprises a first mechanical closure element, preferably a hook fastening material, and said landing member comprises a second fastening component comprising a second mechanical closure element, preferably a loop fastening material, mechanically engageable with said first mechanical closure element.

6. The absorbent article according to any of the preceding claims additionally comprising elasticized side panels disposed in said second waist region laterally outwardly from and along a portion of said side edges of said absorbent core, each of said elasticized side panels being elastically extensible in at least the lateral direction.

7. The absorbent article of Claim 6 wherein each of said elasticized side panels comprises either an ear flap extending outwardly from and along a portion of said side edge of said absorbent core in said second waist region and an elastic side panel member operatively associated with and secured in said ear flap, preferably a zero strain stretch laminate, a zero strain stretch laminate portion and an extension panel portion wherein said elastic side panel member has a length less than the length of said ear flap and extends from said end edge longitudinally inward such that a portion of said topsheet and said backsheet in said elasticized side panel is extended beyond their yield point to form an extension panel in said elasticized side panel that does not concentrate stresses adjacent the leg regions of said elasticized side panel, or an elastic side panel member secured in an elastically contractible condition between said topsheet and said backsheet in said ear flap; or a separate member joined to said containment assembly.

8. The absorbent article of Claims 6 or 7 wherein each of said elasticized side panels has differential extensibility along

its longitudinal axis when stretched in the lateral direction, preferably wherein the lateral extensibility of the portion of said elasticized side panel adjacent said end edge is less than the lateral extensibility of portions of said elasticized side panel longitudinally inwardly from said end edge.

9. The absorbent article according to any of the preceding claims wherein said elasticized waistband comprises a portion of said topsheet, a portion of said backsheet, and an elastic waistband member positioned between said topsheet and said backsheet, preferably wherein said elastic waistband member comprises a heat shrinkable elastic material, an elastomeric foam, or an elastomeric stretch laminate, and more preferably wherein a portion of said backsheet forming said elasticized waistband has been removed to form a windowed elasticized waistband.

10. The absorbent article according to any of the preceding claims additionally comprising a positioning patch located subjacent each said anchor zone for positioning said first attachment component so that said waist closure may more effectively be passively activated, preferably wherein a positioning patch is located subjacent each said first attachment component for positioning said first attachment components so that said waist closure may more effectively be passively activated, more preferably wherein said positioning patches, and most preferably each said elastic side panel member, each comprise an elastomeric foam.

11. An absorbent article, preferably a unitary disposable absorbent article, having longitudinal edges, end edges, a first waist region, a second waist region opposed to said first waist region, an outer surface, and an inner surface, the absorbent article comprising:

a containment assembly comprising an outer covering layer and an absorbent core having side edges and waist edges, preferably said containment assembly comprising a liquid pervious topsheet, a liquid impervious backsheet joined with said topsheet, and an absorbent core positioned between said topsheet and said backsheet, said absorbent core having side edges and waist edges;

elasticized side panels disposed in said second waist region laterally outwardly from said side edges of said absorbent core, each of said elasticized side panels being elastically extensible in the lateral direction; and

characterized in that a dual tension fastening system is disposed on the absorbent article, said dual tension fastening system comprising:

(i) a primary fastening system for providing a variable positioning side closure for the absorbent article by maintaining said first waist region and said second waist region in an overlapping configuration such that lateral tension is maintained around the circumference of the absorbent article to maintain the absorbent article on the wearer, said primary fastening system comprising:

(a) a tape tab disposed adjacent each of said longitudinal edges in said second waist region, each of said tape tabs comprising a first fastening component; and

(b) at least one landing member disposed in said first waist region, said landing member comprising a second fastening component engageable with said first fastening component of said tape tabs; and

(ii) a waist closure system for providing a variable positioning, passively activated, waist closure for the

absorbent article that dynamically maintains/creates lateral tension through at least a portion of said waist, said waist closure system comprising:

(a) a pair of first attachment components disposed in said first waist region, said first attachment components being positioned so as to be longitudinally aligned with said elasticized side panels and laterally spaced from each other; and

(b) at least one second attachment component disposed in said second waist region, said second attachment component being engageable with said first attachment components so that when the primary closure is formed, said second waist region overlaps said first waist region such that said second attachment component engages said first attachment components to dynamically maintain/create lateral tension through at least a portion of said waist.

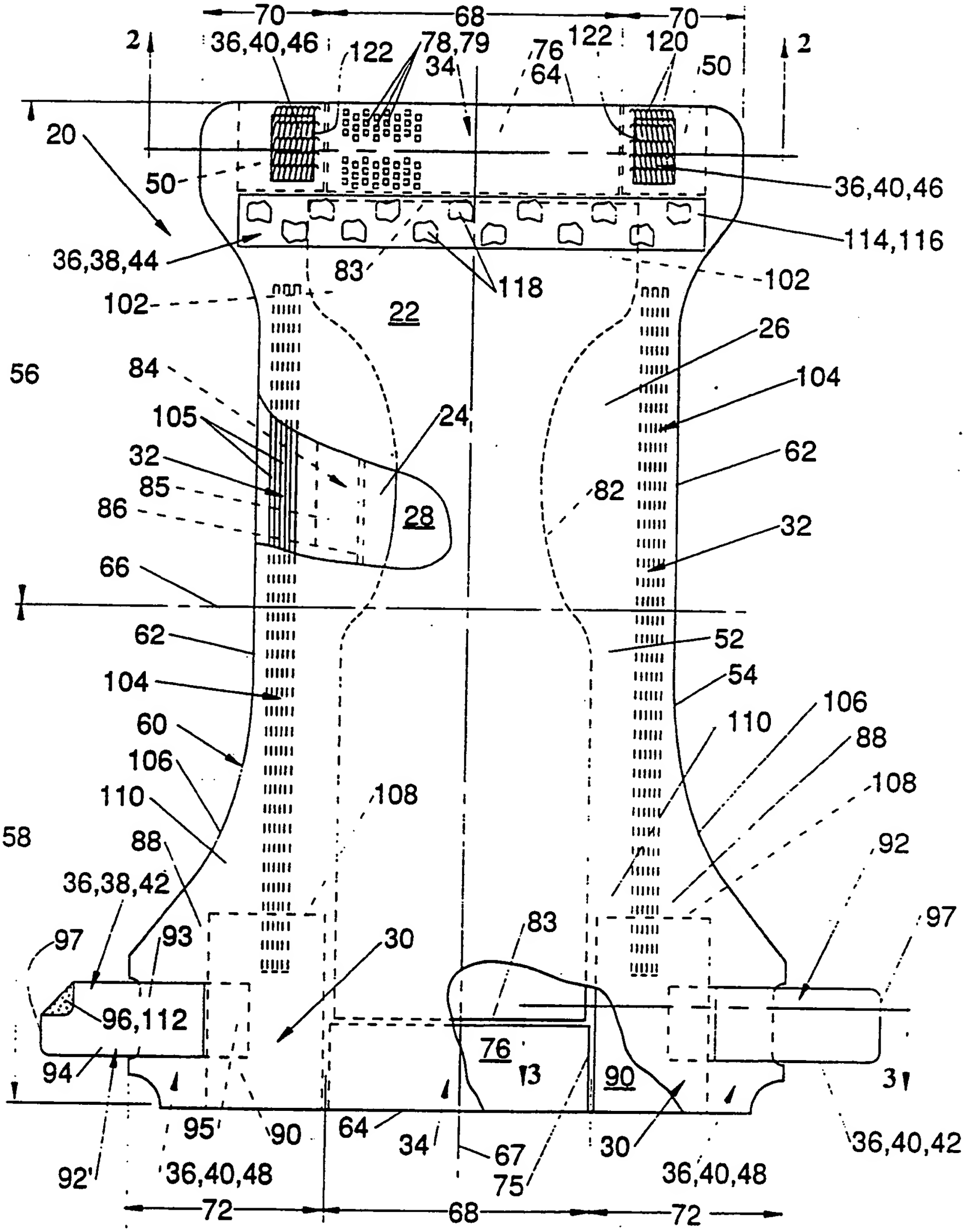
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Fig. 1

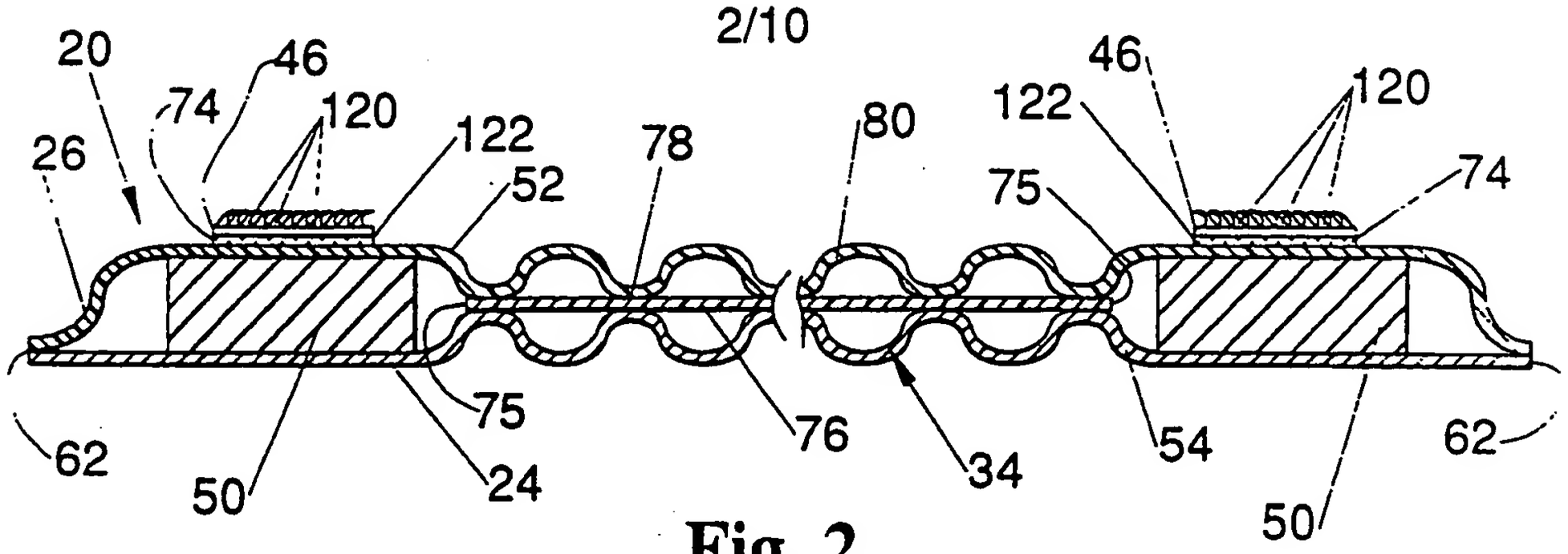
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Fig. 2

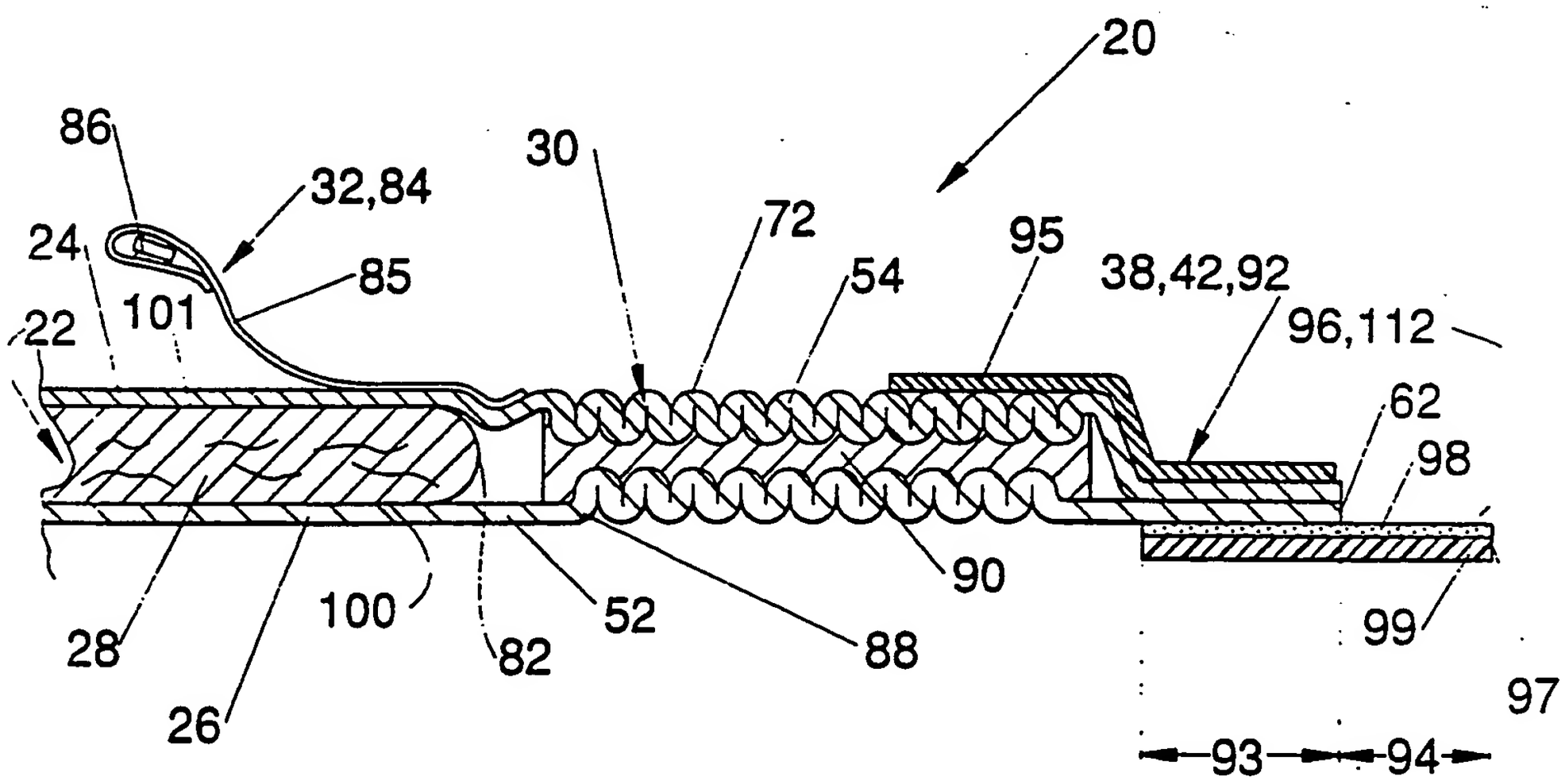
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Fig. 3

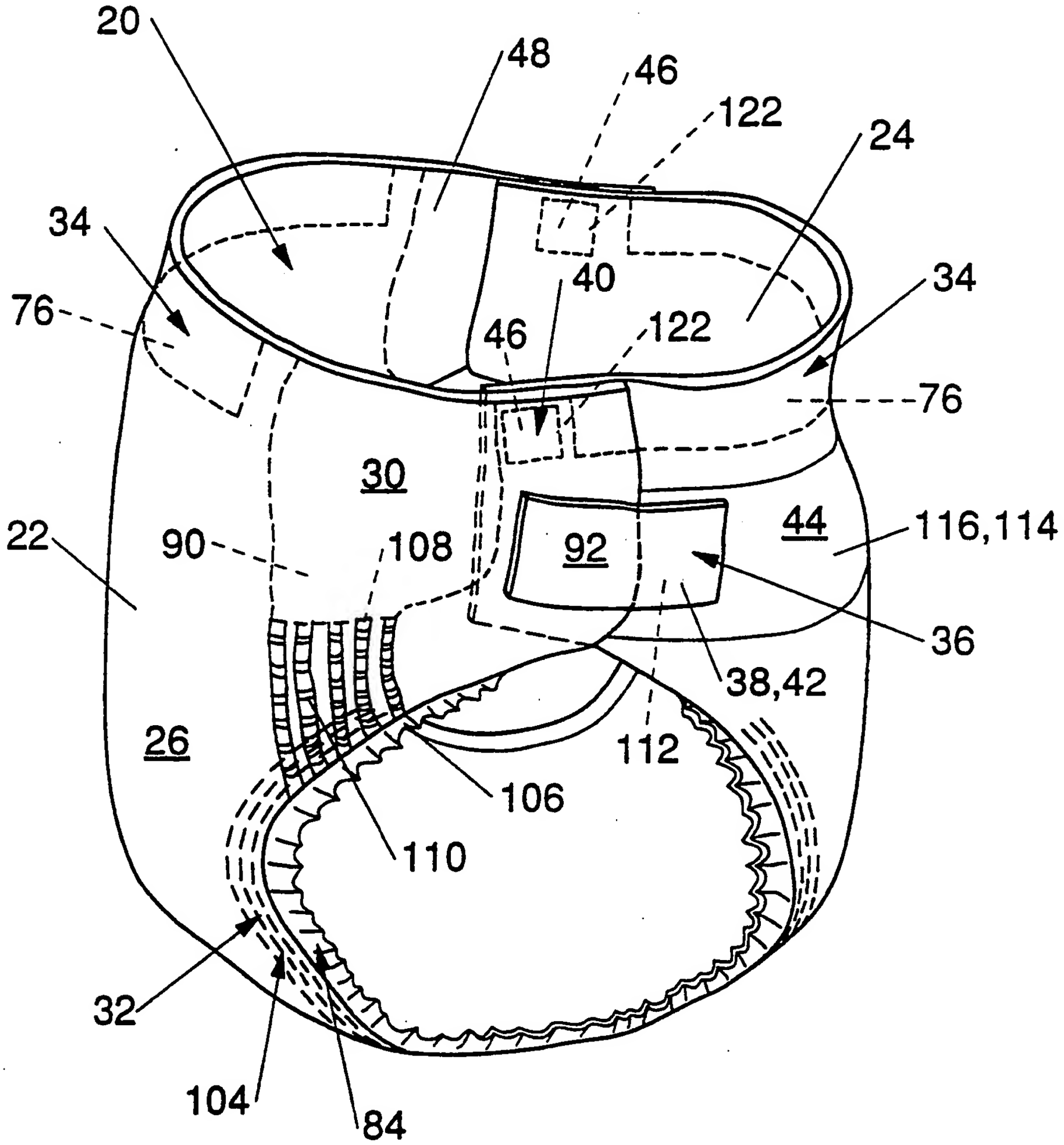
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Fig. 4

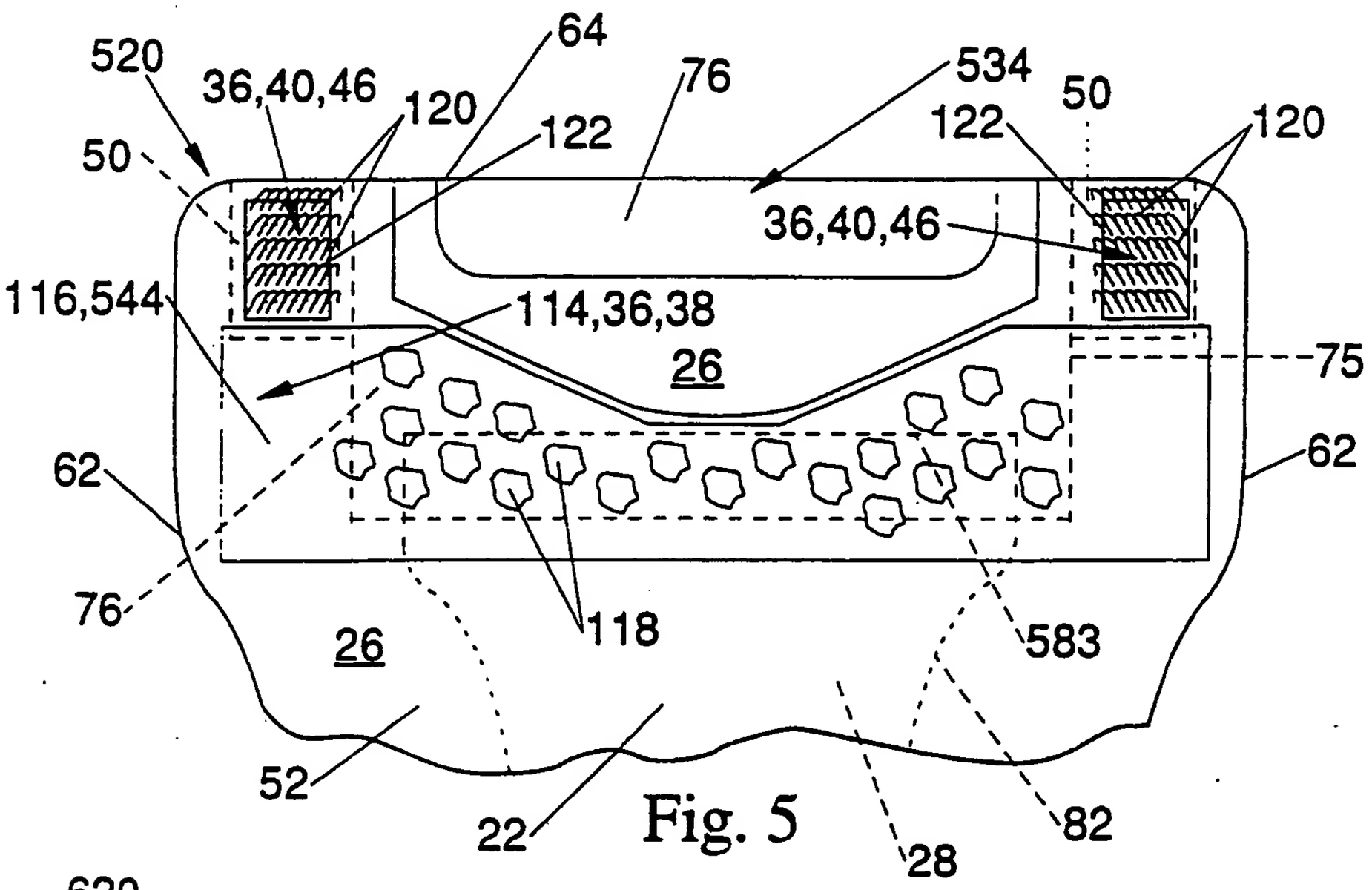
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Fig. 5

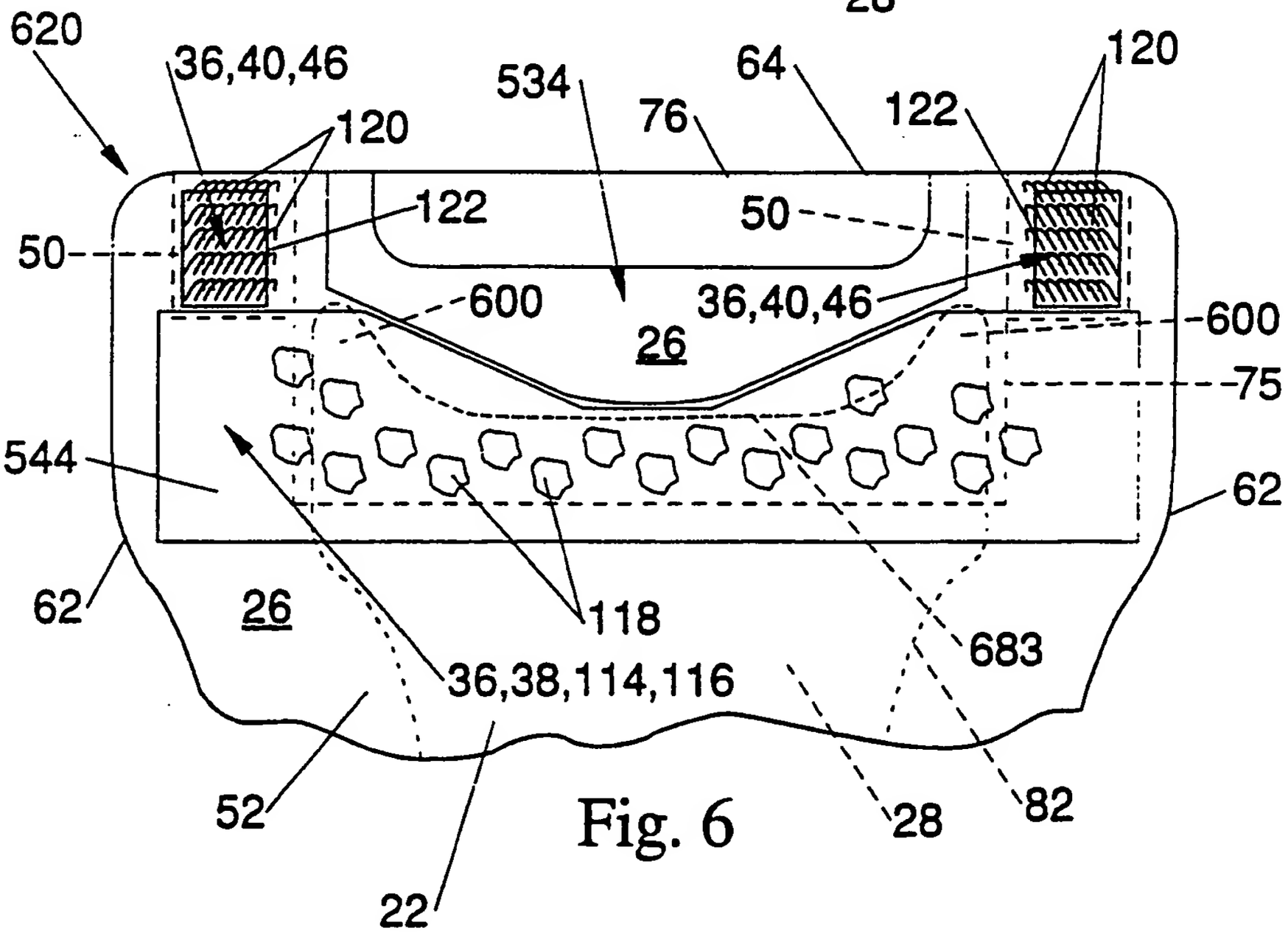
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Fig. 6

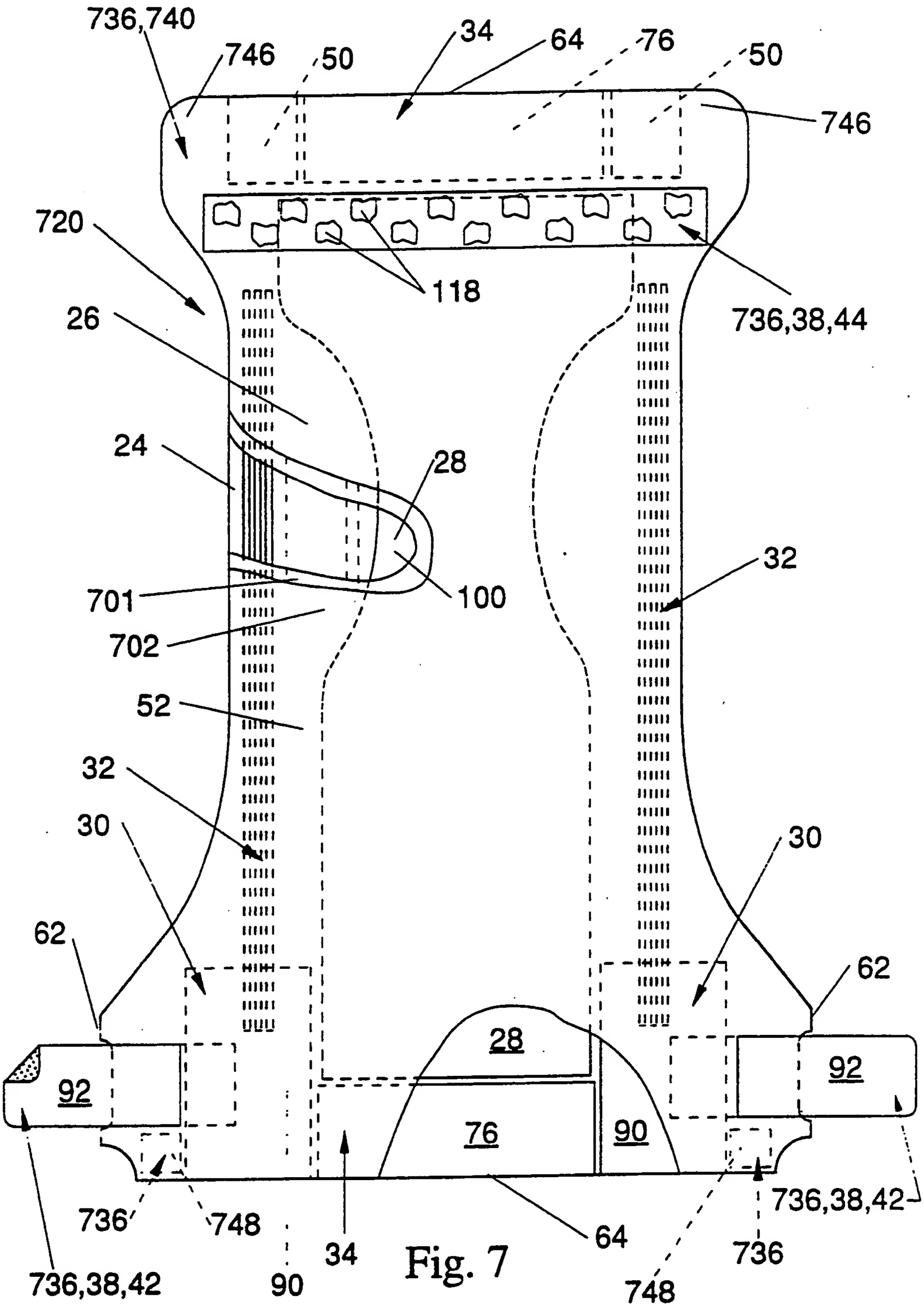
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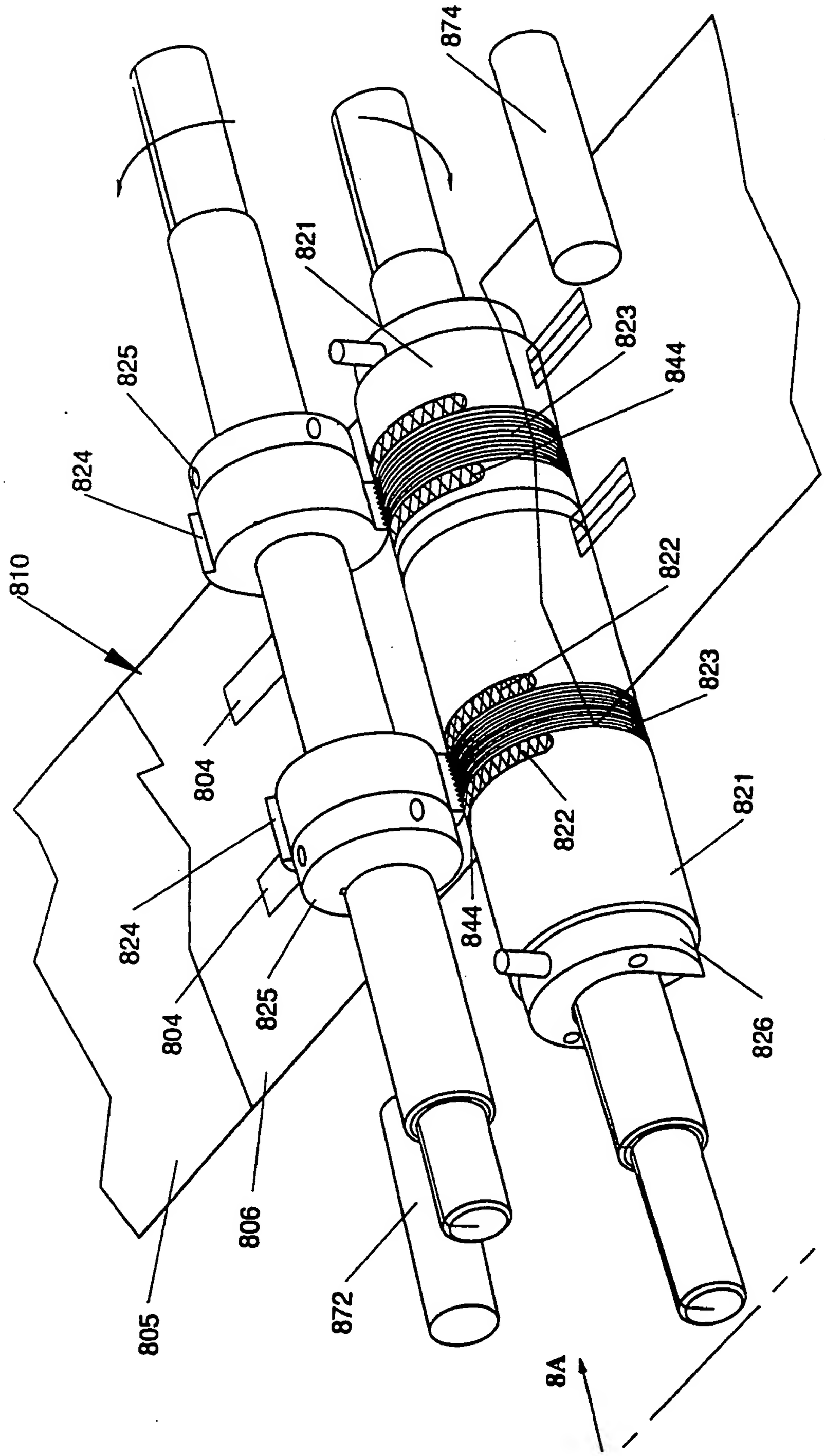
Fig. 7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8A

Fig. 8

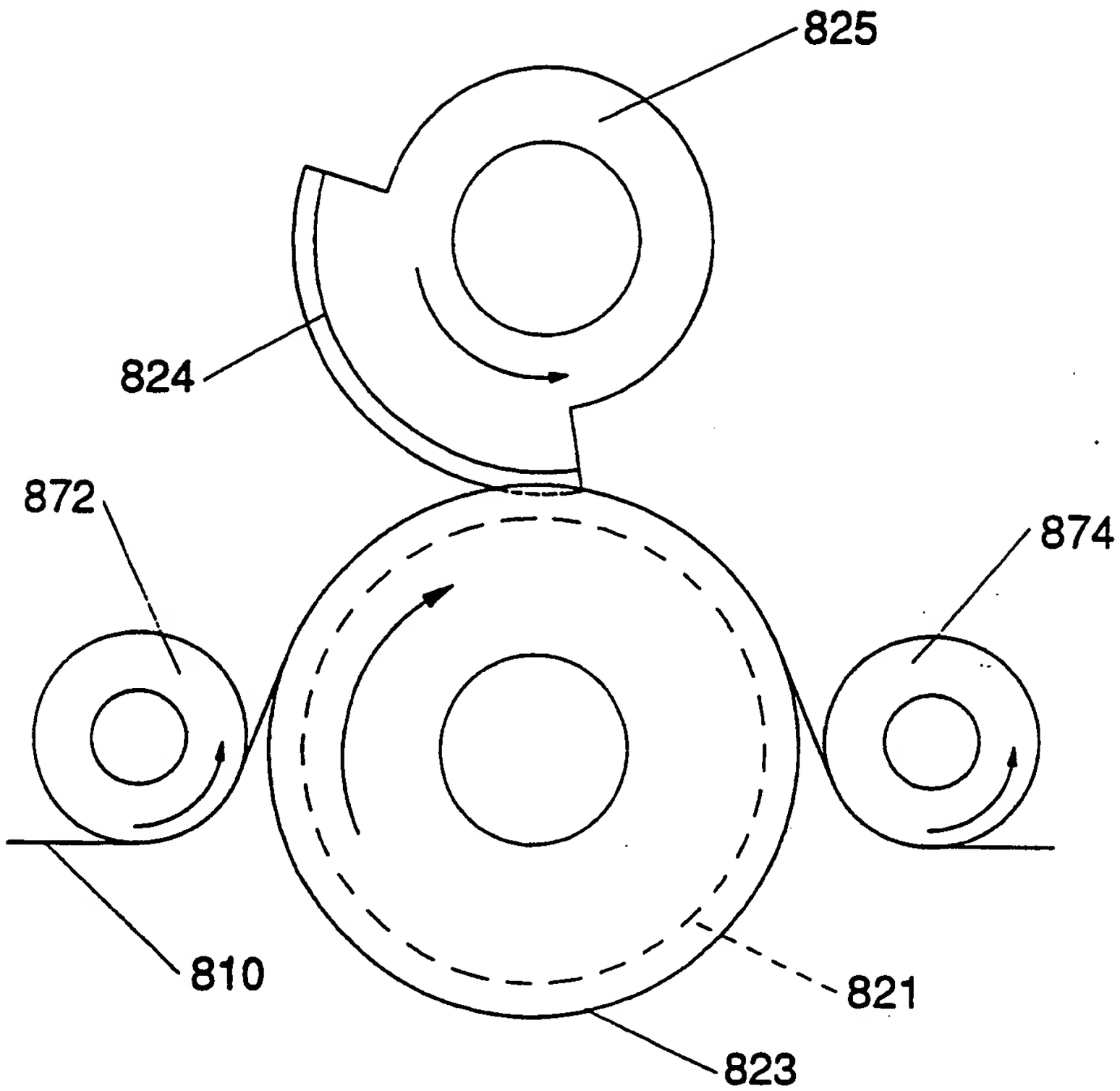

Fig. 8A

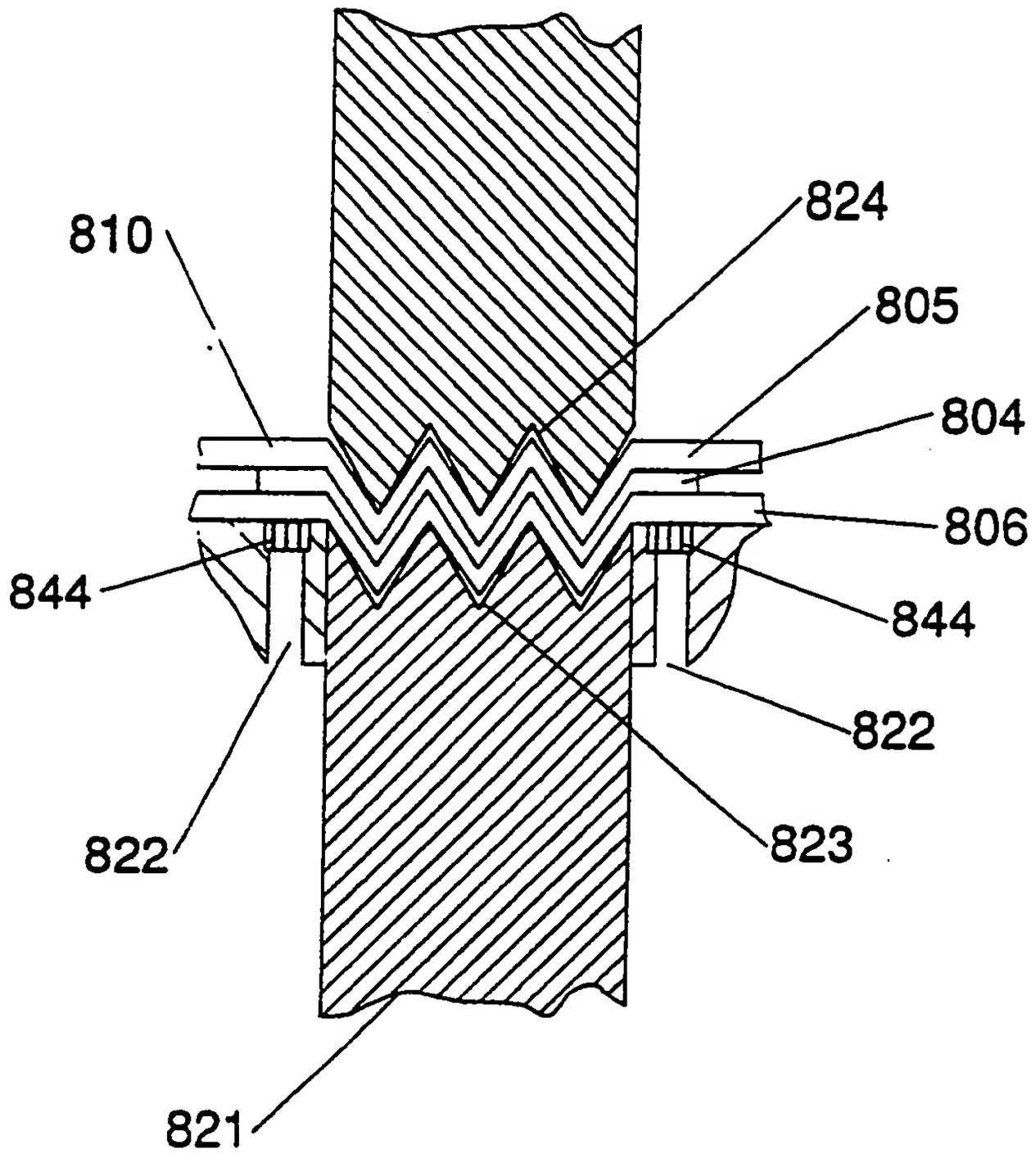

Fig. 8B

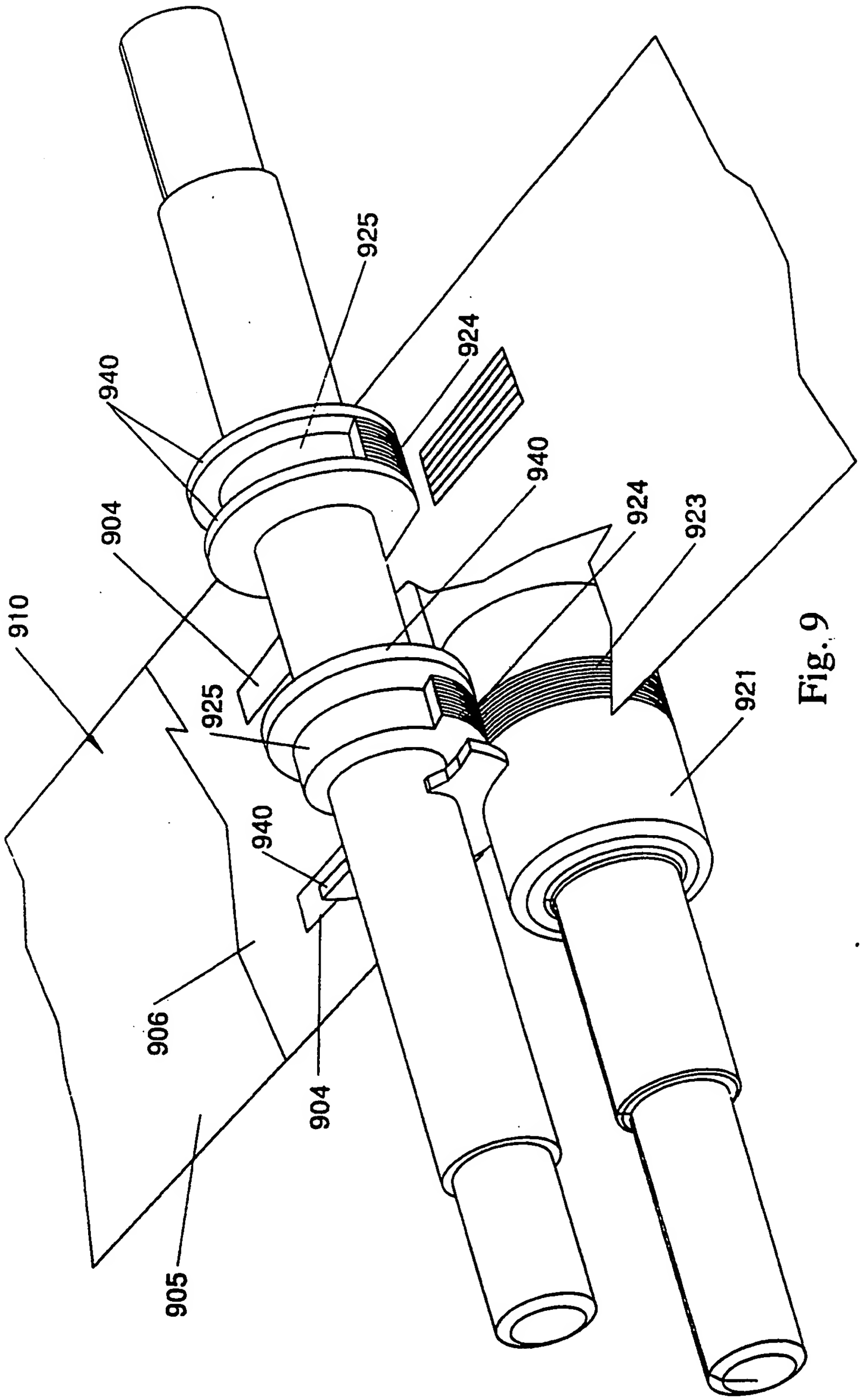

Fig. 9

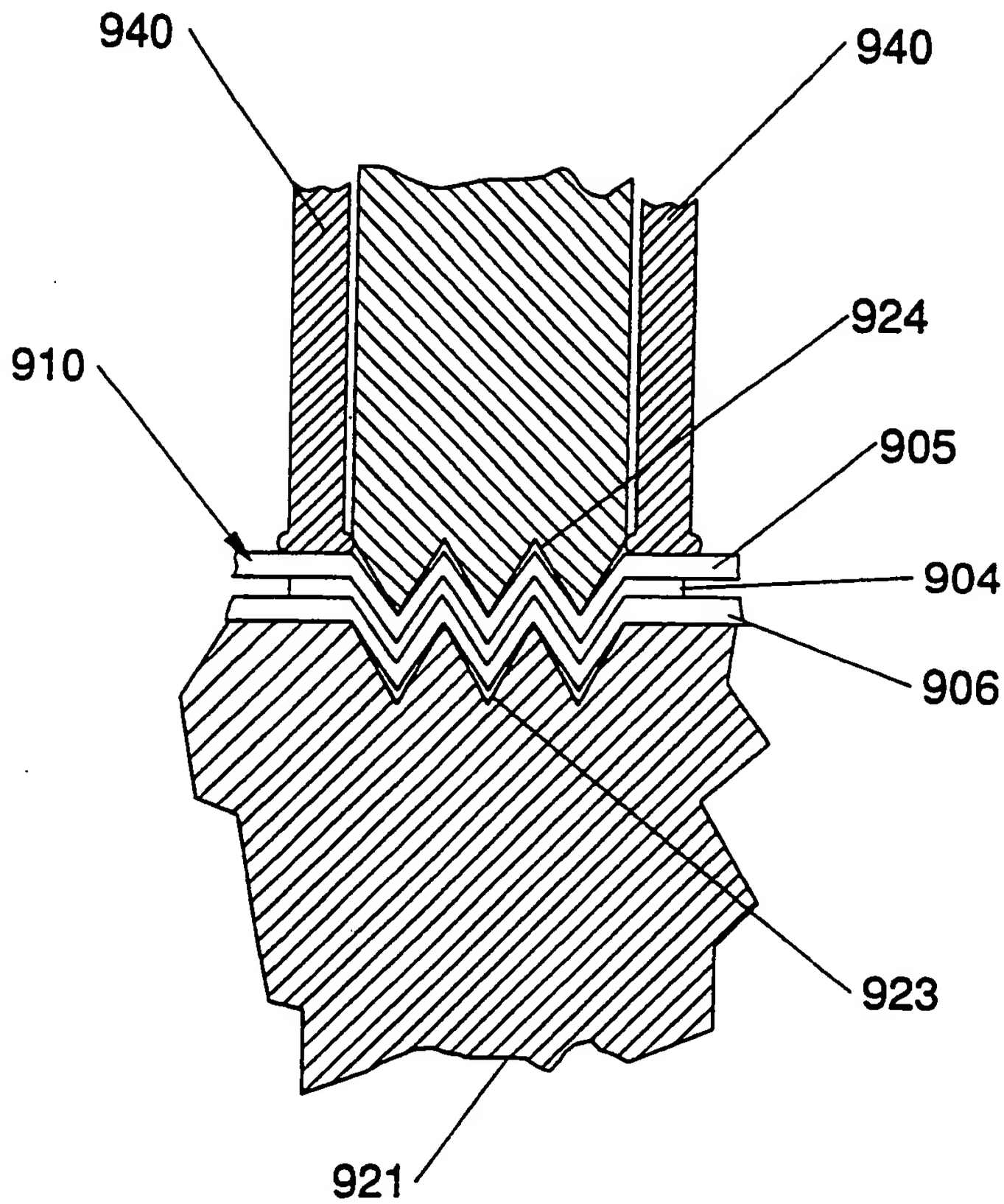

Fig. 9A

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)*

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 A61F13/15

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	A61F

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category °	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
X	US,A,4 850 992 (AMARAL ET AL.) 25 July 1989 see column 1, line 36 - line 43; figure 1	1,2,11
A	US,A,4 857 067 (WOOD ET AL.) 15 August 1989 cited in the application see column 4, line 62 - column 5, line 11; figure 3	4-6,9
A	US,A,4 869 724 (SCRIPPS) 26 September 1989 cited in the application see column 7, line 25 - line 68; figure 1	2,5
A	US,E,33 106 (BECKESTROM) 7 November 1989 see column 2, line 40 - line 47; figure 3	7

-/--

° Special categories of cited documents :[10]

"A" document defining the general state of the art which is not considered to be of particular relevance

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
14 SEPTEMBER 1992	02. 12. 92
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	ATTALLA G.

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category °	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	US,A,4 938 755 (FOREMAN) 3 July 1990 see figure 2 ---	7
A	US,A,4 909 803 (AZIZ ET AL.) 20 March 1990 cited in the application see column 6, line 13 - line 22; figure 3 ---	7
A	US,A,4 834 741 (SABEE) 30 May 1989 cited in the application see abstract -----	7

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. US 9204775 SA 61364

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 14/09/92
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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		JP-A-	2004372	09-01-90
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		US-A-	4968313	06-11-90